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THE BREATHING OF THE FLORIDA MANATEE (TRICHECHUS LATIROSTRIS)

BY G. H. PARKER

A man may live some two months without food, a week or more without water, but only a few minutes without air. This dependence upon an almost immediate supply of oxygen is characteristic not only of man but of all other warm-blooded vertebrates. All such animals die sooner from lack of air than from lack of water or of food. But a number of these warm-blooded forms, both among the birds and the mammals, have adapted themselves to temporary life under water where they are for all practical purposes cut off from the oxygen of the air.

Among the birds the divers exhibit this peculiarity conspicuously, but the recent observations of Alford (1920), of Bolam (1921) and of Taylor (1921) show that ducks and grebes stay under water scarcely a minute and usually not over half a minute.

In this respect the water birds are far exceeded by a number of mammals especially by those that live in the sea, as, for instance, the whales, porpoises, and other cetaceans. Beale (1839, p. 44), who was a surgeon on a whaler and was reputed a good observer, declared that sperm whales could remain under water from an hour to an hour and twenty minutes, and Andrews (1916, p. 57) quotes a case reported by Captain Melsom of a blue whale that remained below the surface 50 minutes, then spouted 20 times, and again went down for 40 minutes. Andrews himself (1909) recorded an instance of a humpback whale that remained under water 20 minutes and of a finback that was under 23 minutes. Whether the older records of an hour or more of submergence will be confirmed or not is a question for the future to settle,

but quite aside from this the very fact that cetaceans may live twenty minutes or more without direct access to air is in itself a most remarkable condition and shows how highly specialized these creatures are as compared with their near relatives the terrestrial mammals.

In addition to the cetaceans the seals and especially the sea-cows or sirenians are mammals that lead an aquatic existence. In fact it is probable that the sea-cows, like the cetaceans, never come upon land at all, but remain always in the water. They inhabit the shallow seas of the warmer regions and are common about the mouths of rivers which they ascend for considerable distances. They are inoffensive quiet creatures feeding upon sea-weeds and other aquatic plants. The east coast of Florida is inhabited by a single species, *Trichechus latirostris* (Harlan), which can often be seen in the waters of Biscayne Bay near Miami. It was during my sojourn at the laboratory of the Miami Aquarium Association, at Miami Beach, Florida, that I had the opportunity of studying three of these animals which were contained in a large outside basin on the grounds of the aquarium. I am indebted to the officers of the Miami Aquarium Association for the opportunity I there had of observing the habits of these sea-cows, especially their respiration, under conditions that were as near natural as possible.

The three sea-cows or manatees, as they are commonly called, had been confined in the aquarium nearly a year. In the course of that time they had become extremely tame and lived a life of sluggishness much as they do in nature. They fed freely on cabbage leaves and appeared in all respects to be in excellent condition. After a full meal they would lie quietly in the water often for hours at a time, their apparent repose being interrupted only by an occasional rising to the surface for air. As is well known they rest under water in a curved position with the head and tail depressed and the back arched up and near the surface. When they rise to breathe, the back usually breaks the surface of the water first, after which the head emerges. Expiration and inspiration are then quickly accomplished whereupon the animal slowly sinks again below the surface of the water. Two or three such respiratory acts commonly occur, one quickly following the other, after which the manatee sinks into the water to remain quietly there for a considerable period. These operations are carried out with slowness and regularity so that it is comparatively easy with a watch in hand to take complete records of as many as three animals at one time.

The three manatees at the Miami Aquarium were of very different sizes so that they were easily distinguishable. The largest one was a female of about three meters in length. The next in size was a male about two and a quarter meters long. And the smallest was a young one of undetermined sex somewhat less than two meters from snout to tail. In the late afternoons these three animals were commonly found lying nearly parallel one to the other and exhibiting no other motion than the occasional respiratory one already described. Under such circumstances continuous records could be kept of the breathing of the animals for periods well over an hour. Each set of records included the lengths of time covered by the breathing periods, the number of breaths in each period, i.e., the number of times the nostrils were brought to the surface and opened and closed, and finally the resting periods or lengths of time each manatee remained quietly resting under water. The details of three such sets of records, each covering about an hour, are given in table 1.

It is evident on inspecting table 1 that in all three sets of records the young manatee came most frequently to the surface to breathe, the male less frequently and the female least frequently. The details of this table are, however, best appreciated by a comparison with table 2 which gives in compact form the general averages from table 1.

On comparing these two tables it will be seen that the breathing period in the young manatee varied from 20 seconds to 3 minutes and averaged 49 seconds. In the male it ranged from 20 seconds to 3 minutes and 20 seconds and averaged 1 minute. In the female it ran from 20 seconds to 3 minutes and averaged 1 minute and 17+ seconds. Although the range in the length of the breathing period is much the same for the three individuals, table 1 shows that short periods are more characteristic of the young, longer ones of the male, and still longer ones of the female.

The numbers of breaths taken in the breathing periods by the three manatees vary in each instance between 1 and 4 except that there is one record of 5 in the breathing of the male. Nevertheless table 1 shows that the young takes a smaller number of breaths, average 1.7—, than the male, average 2.2, and the male a smaller number than the female, average 2.6.

Although it is true that the young manatee came to the surface more frequently than the male and the male more frequently than the female, and, further, that the young one took fewer breaths per period than the male, and the male than the female, it is also true that

TABLE 1

Breathing records of three Florida manatees (Trichechus latirostris) taken from the animals in the Miami Aquarium, set A on June 10, set B on June 13, and set C on June 14. Each set covers a period of about an hour and includes records from a young animal less than two meters long, from a male about two and a quarter meters long, and from a female about three meters long. The breathing periods are given in minutes and seconds. The number of breaths indicates the number of times the head was brought to the surface and the nostrils were opened and closed in each breathing period. The resting periods show the lengths of time in minutes and seconds spent quietly under water

SETS	ANIMALS	PERIODS, ETC.	TIMES IN MINUTES AND SECONDS, ETC.													MEANS
A	Young	Breathing periods	:50	1:15	1:30	:20	:30	1:00	:20	1:00	:30	:40	1:20			:50+
		Number of breaths	2	4	4	1	1	2	1	2	1	2	3			2:1−
		Resting periods	4:10	3:30	7:20	2:20	3:00	3:20	4:40	5:40	3:50	4:40	6:20			4:26+
	Male	Breathing periods	1:25	:25	1:10	:40	:30	1:00	:40							:50
		Number of breaths	3	1	3	2	2	3	2							2.3−
		Resting periods	9:00	4:40	8:25	6:40	5:10	7:40	7:40							7:02+
	Female	Breathing periods	1:20	:40	1:00	:50	:50									:56
		Number of breaths	3	2	3	2	2									2.4
		Resting periods	12:50	8:40	7:20	15:10	12:10									11:14
B	Young	Breathing periods	:20	:30	1:30	:20	1:20	:25	:20	:30	1:00	:20	:25	:20	:30	:36+
		Number of breaths	1	1	2	1	2	1	1	1	2	1	1	1	1	1.2+
		Resting periods	9:30	3:30	2:00	7:30	4:00	4:00	2:30	3:00	5:30	8:00	2:10	4:00	4:20	4:37−
	Male	Breathing periods	:30	3:30	2:00	:30	1:10	1:00	:50							1:21+
		Number of breaths	1	5	4	1	3	2	2							2.6−
		Resting periods	13:00	9:00	11:30	5:30	8:15	7:20	9:40							9.11−
	Female	Breathing periods	1:00	3:00	1:30	:20	1:00									1:22
		Number of breaths	3	4	3	1	3									2.8
		Resting periods	14:00	11:20	12:30	13:00	14:00									12:58

C	Young	Breathing periods	3:00	1:00	1:20	:30	:20	1:00	:20	:30	1:00	1:30	1:00		1:03−
		Number of breaths	2	2	2	1	1	2	1	1	2	3	2		1.7+
		Resting periods	4:00	6:30	6:10	6:20	2:10	4:50	5:00	4:20	3:10	4:50	5:20		4:47+
	Male	Breathing periods	:40	:50	:30	:20	1:20	1:00							:47−
		Number of breaths	2	2	1	1	2	2							1.7−
		Resting periods	10:30	9:50	10:40	8:20	9:30	10:10							9:50
	Female	Breathing periods	1:40	:50	2:00	1:30	1:50								1:34
		Number of breaths	3	2	3	2	3								2.6
		Resting periods	14:00	8:00	12:20	9:40	15:10								11:50

the lengths of breath, i.e., the time that the nostrils are open, is about the same for the young, 30− seconds, that it is for the male, 27+ seconds, and for the female, 30− seconds. In other words, the actual breathing operation occupies an interval of time which was about the same for all three manatees. This unit is used in small multiples by the young, 1.7− in larger multiples by the male, 2.2, and in still larger ones by the female, 2.6.

The interval between two breathing periods is the resting period during which the manatee is reposing quietly under water. During this interval the animal is cut off from its supply of air and hence the length of this period is a measure of its adaptation to submergence. The resting period in the young varied from 2 minutes to 9 minutes and 30 seconds with an average of 4 minutes and 37− seconds; in the male it ranged from 4 minutes and 40 seconds to 13 minutes with an average of 8 minutes and 38− seconds, and in the female it varied from 7 minutes and 20 seconds to 15 minutes and 10 seconds with an average of 12 minutes and 1− second. In general it may be said that taking the period of submergence in the young as unity that in the male was nearly two and that in the female nearly three.

TABLE 2

Average breathing periods in minutes and seconds, average numbers of breaths in each breathing period, average resting period in minutes and seconds, and average length of breath in seconds for the three manatees recorded in table 1. The results are computed from the figures in that table

	YOUNG	MALE.	FEMALE.
Breathing periods	:49	1:00	1:17+
Number of breaths	1.7—	2.2	2.6
Resting periods	4:37—	8:38−	12:01−
Lengths of breath	:30—	:27+	:30−

As the young manatee was the smallest of the three, the male next in size, and the female the largest, there appears to be a fairly intimate relation between the size of the animal and its respiratory activities, for the larger the manatee the longer its breathing period, the greater its number of breaths in each such period and the longer it remained under water.

A number of other sets of records were taken from the manatees in addition to those given in table 1, but these sets were incomplete as compared with the three already tabulated in that, instead of extending

over an hour, they were shorter having been interrrupted by the unexpected resumption of swimming on the part of one or more of the manatees. Under such circumstances breathing became very much more rapid and the animals moved over the surface of the water in such a way that it was impossible to record accurately their respiratory activities. These incomplete records in so far as they appertain to resting animals show, however, nothing that is not to be seen in the complete records except a maximum period of submergence. In one instance among these incomplete sets the female is recorded as having remained under water 16 minutes and 20 seconds. This is the longest period for a manatee to be under water of which I have a record and exceeds the maxima in table 1 by over a minute. Aside from this the incomplete sets contain nothing of special interest.

It has been stated by some observers that the sea-cows are nocturnal in their habits, but the three animals that came under my observation showed no evidence of this. I often visited at night the pool in which they were kept and I never noticed at that time any greater activity in it than I did during the day time. In the darkness of night it was much more difficult to observe the manatees than in the day, but the large female could be commonly identified in the dim light of night and I have a number of sets of records of her breathing rate at that time. In obtaining these records I usually placed myself on the edge of the pool as close as possible to her head and listened for her breathing as she came to the surface reading the time from a watch kept near at hand and lighted by a flash-light so held as not to illuminate the pool. In this way I found that she was acting much as she did in the daytime and that her submergence or resting periods averaged about 12 minutes. In listening for her breathing I held my face as near the surface of the water as the edge of the pool would permit and on her first emergence she often blew her breath directly in my face. It was far from aromatic, as described by Drexler and Freund (1906, p. 80) for the dugong, but had a most repulsive smell resembling somewhat that of phosphorus. This may have been due to the fact that she with the other two in the pool were fed regularly on cabbage.

The periods of submergence for manatees recorded in this paper agree fairly well with those already contained in the literature. These older records were not very systematically gathered and most of them are of the nature of incidental notes rather than extended statements. The resting or submergence period for American manatees are given by the authors quoted as follows: Chapman (1875, p. 461) about 1 to

1¼ minutes, Brown (1878, p. 296) on the average 2½ minutes, Crane (1881, p. 457) 2 to 3 minutes with a maximum of 6 minutes, Noack (1887, p. 296) every 2 to 3 minutes, and Townsend (1904, p. 86) 5 to 8 minutes, a statement repeated by Gudernatsch (1908, p. 232). The African manatee is said by Noack (1887, p. 300) to come to the surface for breathing every 1½ to 2 minutes. The eastern sea-cow or dugong has been reported upon in the same incidental way and with much the same range. Thus Rüppell (1834, p. 113) stated that this sea-cow comes to the surface every minute or so for breathing; Klunzinger (1878, p. 68) gives the rate as once in 10 minutes; and Semon (1896, p. 317) as every 3 to 5 minutes. Dexler and Freund (1906, p. 80) observed the breathing rate in a newly captured dugong to vary from 17 to 65 seconds between breaths and in the imprisoned condition to vary from 43 to 145 seconds. Obviously these more rapid rates both for the manatee and for the dugong are to be ascribed to changes in the animal's activity and not to irregularities of observation, for, when a manatee begins to swim, it at once increases its rate of breathing which may rise to several times a minute. It is only with really quiet animals that such a period as 16 minutes or more is to be observed and then only when the animal is very large (3 meters long, for instance), conditions of observation which have rarely occurred in earlier work.

Florida and West Indian fishermen maintain that when the native manatee is hunted, it will dive and remain under water fully half an hour. Whether this is so or not remains to be seen, but it is not impossible that submergence periods exceeding considerably those given in this paper may be eventually reported.

The observations recorded in this paper show that manatees may remain under water much longer than diving birds or terrestrial mammals and that their normal periods of submergence are so considerable that they must be regarded as specially adapted to an aquatic life though they are obviously much less specialized in this respect than are the whales, porpoises, and other cetaceans. The fact that they bleed profusely when butchered and are what the fishermen call "full-blooded" is one feature in this adaptation, for their blood is probably their chief storage place for oxygen.

SUMMARY

The Florida manatee, *Trichechus latirostris* (Harlan), is highly specialized for an aquatic life. Its breathing is related to its size in that the larger the animal the longer it can stay under water, the

longer it breathes at the surface, and the more breaths it takes while breathing. A small manatee, less than 2 meters long, had an average breathing period of 49 seconds during which it averaged 1.7− breaths. A large manatee, three meters long, had an average breathing period of 1 minute and 17+ seconds during which it averaged 2.6 breaths.

The small manatee had an average submergence period of 4 minutes and 37− seconds with a maximum of 9 minutes and 30 seconds. The large one had an average submergence period of 12 minutes and 1− seconds with a maximum of 16 minutes and 20 seconds. These submergence periods far exceed those of diving birds and terrestrial mammals, but are not so long as those of cetaceans.

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RODENTS AND RECLAMATION IN THE IMPERIAL VALLEY[1]

By Joseph Dixon

Human occupancy of a region always results in great changes in the animal life therein. Species of mammals, for instance, that afford man meat, hides, or fur are almost sure to decrease in number, whereas other species, including some that are harmful to man's interests, frequently increase. In the case now under discussion, both classes of animals are represented.

The recent reclamation of the major part of the Imperial Valley, which occupies the southern portion of the Colorado Desert in the southeastern corner of California, is of unusual interest in many ways, but particularly so in connection with its widespread influence on the distribution and abundance of the rodents of that region. The area involved consists of the entire delta of the Colorado River. This delta is one hundred miles in length and has an average width of thirty miles; it extends from Salton Sea on the north to the Gulf of California on the south, and from the Cocopah Mountains on the west to Arizona and Sonora on the east. About one half of the delta lies within the United States, whereas the other half lies south of the Mexican boundary in Lower California and Sonora.

That part of the delta region lying within the Imperial Valley in the United States is practically all below sea level. From surveys made in 1915 the elevation of the Imperial Valley was found to vary from sea level at Calexico to 234 feet below sea level at Salton Sea. In Lower California nearly all of the delta is above sea level. The crest or divide of the delta lies several miles south of the International Boundary.

The Colorado Desert, including the delta region, is characterized by marked aridity and extremely high summer temperature. Extensive areas on both the east and west margin of the Imperial Valley are occupied by hundreds of sand dunes. The rich alluvial soil of the delta is over one hundred feet in depth for hundreds of square miles. Previous to the construction of the irrigation system the Alamo and New Rivers, both being overflow channels of the Colorado River, were the only waterways of any size and importance traversing the northern half of the delta. Both of these were intermittent rather than permanent streams.

[1] Contribution from the University of California Museum of Vertebrate Zoology.

Under the original desert conditions only true desert vegetation flourished in Imperial Valley and much of the best land of the delta was covered with creosote-bush, arrow-weed and quail-brush (*Atriplex*). Mesquite was most common in sandy areas where it helped in the formation of sand dunes. Cottonwood, willow, cat-tails, cane and other riparian trees and plants were restricted to sloughs along the overflow channels. Under true desert conditions in the Colorado Delta certain rodents were closely associated with certain plants or certain types of ground. For example, the pallid muskrat (*Ondatra zibethica pallida*) and Sonora beaver (*Castor canadensis frondator*) were confined to the river, ponds, and other permanent waterways. The western desert cottonrat (*Sigmodon hispidus eremicus*) and desert harvest mouse (*Reithrodontomys megalotis megalotis*) were typical inhabitants of the sedge or tule along the banks of streams. The Colorado Valley woodrat (*Neotoma albigulà venusta*) was a characteristic dweller of mesquite thickets. The Yuma round-tailed ground squirrel (*Citellus tereticaudus*) and allied kangaroo rat (*Dipodomys merriami simiolus*) were two typical inhabitants of the dry sand dunes, while the Imperial Valley gopher (*Thomomys perpallidus albatus*) was found sparingly in sandy places where sufficient food could be had. The gopher, being unable to forage about for any great distance above ground, had the most restricted distribution of any of the mammals.

Having ascertained conditions as they existed prior to the reclamation of Imperial Valley, the changes that have taken place there during the past fifteen years may now be noted. One of the first and most important changes was the construction of a network of irrigation canals. These vary in width from four to one hundred and sixty feet; their aggregate length runs into hundreds of miles, there being over three hundred miles of main canals to say nothing of the laterals. The removal of the native vegetation and the breaking up and cultivation of hundreds of thousands of acres soon followed. The levelling of the land so that all parts of a field might be flooded during the frequent summer irrigation came next. Alfalfa and cotton fields now mark the former site of extensive stretches of creosote and other desert vegetation. Man's occupancy of the region also resulted in the destruction of many of nature's best rodent destroyers. This reduction, by man, in the numbers of snakes, coyotes, wild cats, kit foxes, coons, badgers, hawks, and owls has especially assisted certain rodents, such as gophers, in their rapid increase, since it removed one of their most important natural checks.

The three most important conditions necessary for the successful life of any species of animal, as pointed out by Grinnell in his Colorado River Report, 1914, are adequate food supply, safe breeding dens and places for temporary refuge in extremity. A sufficient supply of the proper sort of food is the first requirement. Unless safe breeding dens are availabe the future generations of a species are placed in jeopardy. To a kangaroo rat that is being closely pursued by a hungry kit fox the nearness of a protecting burrow may be a question of life or death. With these esssentials of rodent existence in mind, let us note the effect of the recent radical changes in Imperial Valley on the various species involved.

Field work carried on by the writer in March and April, 1921, in the Imperial region on both sides of the International Boundary, showed that the rodent population of that region could be readily divided into two classes. The first class consists of rodents that tend to be driven out by reclamation. Belonging to this category are the round-tailed ground squirrel, Colorado Valley woodrat, kangaroo rat and pocket mouse.

The other class is composed of species that have benefited by, and increased as a result of, the reclamation of desert lands. The harvest mouse, cotton rat, beaver, muskrat and gopher belong to this second class. The species that are driven out by reclamation are those that are most abundant in the sand dune areas. The true desert rodents are able to live without water other than that obtained from the food that they eat; as a matter of fact, irrigation drives them out. With the one exception of the gopher, the rodents that have increased under reclamation are all water or stream-side dwellers.

Reclamation in Lower California has not been carried on as rapidly or as extensively as it has on the American side, and as a result large areas still remain where wholly natural conditions prevail. An excellent chance was thus afforded for observing original conditions and for seeing reclamation forces in actual operation. The immediate results of different stages of reclamation and irrigation were also observed. In one instance, an area one mile long and one-half mile wide lying just south of the border and eleven miles east of Mexicali was studied in detail. One half of this selected area was covered by original mesquite crowned sand dunes surrounded by patches of arrow-weed and quail brush. The rest of the tract had recently been or was being cleared, leveled, and planted to cotton or alfalfa. The ground squirrels, pocket mice, kangaroo rats and woodrats that had formerly inhabited the

land were thus forced to seek protection in the sheltering mesquite thickets of the adjoining sand dunes. Periodic flooding of the fields during irrigation destroyed the burrows of such rodents as returned to their former homes in the cultivated fields. This concentration of the rodent population meant increased competition for food. At the same time the food producing area was greatly reduced especially where cotton was raised. As a result, considerable damage was done, particularly by the little squirrels (*Citellus*), to grain fields that were enclosed or bordered by mesquite thickets. Some difficulty also resulted from the burrowing of the rodents, chiefly squirrels, into sandy irrigation ditch banks between irrigations. Some ditches or levees that remained unused for a few months were thus rendered useless. The abundance of squirrels at this locality was indicated by four being caught in as many days in one trap set at the mouth of one burrow. Poisoning with barley coated with strychnine afforded temporary relief, and the gradual settlement of the land resulting in the complete removal of the sand dunes, which are being leveled into fields, means that this first class of rodents will soon be controlled and in many instances exterminated over large irrigated areas. In other words, once their food supply, breeding dens and temporary refuges, the essentials of a successful existence, are all destroyed, the rodents will cease to exist.

In considering the rodents that have increased through reclamation, we find that the construction and use of irrigation canals has been the fundamental cause of their successful battle for existence. The irrigation ditches have simply served as highways for the spread of aquatic or stream-side animals. Thus, harvest mice and cotton rats have followed down along the canal banks through Lower California from the Colorado and Alamo Rivers until they are now to be found in considerable numbers in American territory. On March 17, 1921, the writer found many well-defined runways and trapped an adult breeding male cotton rat one half mile south of the International Boundary near Allison Heading. Six harvest mice were also captured in the cotton rat runways. Extensively used cotton rat runways were also found in Imperial County on the American side of the line, so that this unwelcome rodent is now definitely known to be established in the cotton districts of Imperial Valley. It is unlikely that the harvest mouse will do any considerable damage, but the cotton rat is dangerous. In Texas and certain other gulf states cotton rats have on occasion proved very destructive to cotton and corn crops. These

rats invade cotton fields and carry off the cotton in order to secure the seed of which they are very fond. M. C. Rissinger, who for nine years has been stationed at the Eastside Heading on the main Imperial canal, reports finding a cache of cotton three feet in diameter that had been accumulated by a pair of cotton rats. The Colorado River species, therefore, has the same destructive habits as the related species of the gulf states.

The Sonora beaver, one of the largest living rodents in North America, is common in the Colorado delta. This aquatic species was formerly common all along the Lower Colorado River, but has been greatly reduced in numbers by persistent trapping. It is still abundant in the lower delta region about Volcano Lake. Beavers have invaded the Imperial Valley along two different routes: by the Alamo River and main Imperial Canal on the east side of the delta, and by way of the Black Butte Canal on the west side. At the present time there are in the neighborhood of 100 beavers in the Imperial Valley north of the International Boundary. Nearly half of these are to be found in the Alamo River, whereas the others are scattered about in the larger canals. No beaver sign was noted along New River on the American side. A thriving colony has been established for some time on the Alamo within half a mile of the center of the town of Holtville. Four recently cut willow saplings were noted at this point on March 25, 1921, and many willows, cut by beavers, have lodged against the trestle work of the Holton Interurban bridge west of Holtville. Serious breaks have already been caused by beavers burrowing into canal banks, and it is probable that other breaks will occur especially at points where the canals are built above the general land surface. Complaints of damage to canals by beavers have already been registered from the Imperial Valley, and it is likely that this damage will increase. Beavers are protected by law at all seasons in California. The state law protecting them provides that, where they are endangering the levees, permits to trap or remove them may be issued upon the proper application to the State Fish and Game Commission. However, if it were possible to remove all of the beavers from the American side of the boundary, it would only be a question of a short time until the canals would be reinfested from the breeding stock in Lower California since they have free access along all of the main canals, and beavers and muskrats do not need passports in crossing the International Boundary. While the fur of the Sonora beaver is short, pale and of poor quality, pelts of this animal sell for an average

of about eight dollars each in ordinary years, and in 1920 large raw skins sold for as much as twenty dollars. There appears to be no good reason why the beavers should not be removed wherever they are endangering the canal banks. The value of the pelt should defray the cost of the trapping if this is done at the proper season when the fur is prime and hence of greatest value.

In April, 1894, Dr. E. A. Mearns saw what he believed to be muskrat sign near Seven Wells on the Alamo (Salton) River. It is probable that a few muskrats existed along this stream prior to the construction of the Imperial irrigation system. Muskrats are now to be found in all of the main irrigation canals carrying over ten second feet of water between Salton Sea and the Gulf.

A conservative estimate based upon careful investigation places the present muskrat average population per mile as follows: Large main canals, 40; small mains, 20; Alamo River, 20; New River, 40 (and in places up to 200 per mile). In 1920, 67 muskrats were actually trapped during a single night in a distance of one mile along New River, and at least twice as many were left untrapped. Over 400 muskrats were taken by one trapper in twenty nights on the Brawley main. This trapper set his traps only one night in each place, and trapped about one mile of canal a night. In three months, W. W. Morrison and assistant, caught 1738 muskrats. From the known number of trappers and their catch it is conservatively estimated that 25,000 muskrat pelts were shipped out of the Imperial Valley during the trapping season of 1919–20. It is further believed that the catch (25,000) equaled one half the total population of muskrats.

Muskrats breed every month in the year in the Imperial Valley. Small woolly juvenals barely able to leave the nest and forage for themselves have been caught in mid-winter, and small young have been trapped during every month of the year. The bulk of the young are born between February 15 and October 30. Three and possibly more litters are raised in one year. The litters are relatively small. The average number of embryos in twenty-three pregnant females was six, with three and nine as extremes.

In the Imperial Valley muskrats live and forage entirely within the canals and other waterways. The writer has been unable to find a single instance where muskrats have gone out from the canals and injured growing crops in the adjoining fields. The favorite food of this rodent consists of the natural vegetation, such as cat-tail and grass roots, which grow along the inner banks and tend to clog up the

canals. The pallid muskrat is a typical burrow-dweller. This animal is reported to build houses in certain cat-tail swamps near Salton Sea, but none of the trappers interviewed, or the writer, has ever been able to locate such a muskrat house. It is believed that the mildness of the winter climate makes houses unnecessary to the animal. Some damage is certainly done by muskrats burrowing into canal banks, but this is comparatively slight considering the total numbers that live in the canals. The writer dug out a number of burrows in canal banks and found that much of the damage attributed to the muskrat was really being done by the gopher. None of the muskrat burrows dug out, was found to extend over half-way through the embankment. Normally these rodents begin from one-half to three feet below the water line and burrow straight into the bank. Where the bank is high close to the water's edge, the burrows were found to extend in for two or three feet and then turn abruptly upwards, ending in a nest cavity which is usually placed just above the highest high-water mark. If the bank is low, the rats sometimes burrow over the crest of the bank to reach a protecting clump of brush under which the nest is built. Where two canals are close together, muskrats sometimes burrow from one to the other. They sometimes cause breaks by burrowing around wooden head gates, through which they have been known to gnaw small holes. On the whole, damage to headgates and canal banks, due solely to muskrats, was not found to be as extensive as reported.

Prime muskrat pelts, even if from the warm Imperial Valley, have a decided value. During the trapping season of 1918–19, W. W. Morrison of Holtville caught 1124 muskrats which sold for $1,108.00, an average of nearly one dollar a pelt. The highest price received for one pelt during that season was two dollars. In 1919–20 Morrison caught 1738 muskrats which sold for $2,805.00, an average of $1.61 per pelt. Out of this lot of 1738 skins, five extra large pelts sold for five dollars each and 82, number 1 large, sold for four dollars each. At Eastside Heading, below the boundary, M. C. Rissinger secured 333 muskrats in 1919–20. These skins were mostly small, yet they sold for $456.25, an average of $1.34 per skin. Allowing a value of $1.25 a pelt, which is a very low estimate, we find that the 25,000 muskrats caught in the Imperial Valley in 1919–20 yielded the trappers an income of over $31,000.00. This record places the muskrat first as to number taken, and second in aggregate value, among the fur bearers of California for that year.

On account of numerous breaks in the canals caused by the burrows of various rodents, including the muskrat, the ditch tenders and some of the irrigation companies consider muskrats as pests, and often men are hired or paid a bounty to trap the animals. The bounty is paid not on the muskrat's head but on his tail so as not to detract from the value of the pelt. There is no gainsaying the fact that muskrats do cause a certain amount of damage. However, the evidence indicates that the damage has often been exaggerated, and investigation has shown that many of the breaks in the canals were not due to muskrats at all. In one instance an extensive break said to have cost upwards of five thousand dollars was widely reported to have been caused by muskrats, but Mr. Rouse, chief engineer of the Imperial Irrigation District, assures me that this particular break was really due to cracks in the soil of the canal bank and not to muskrats at all. However, two out of fourteen of the mutual water companies in the valley do pay a bounty of twenty-five cents on muskrat tails.

Practically all of the professional trappers wait until December, when fur is prime, before they start trapping muskrats. As one trapper said: "It doesn't pay to trap a muskrat in August for twenty-five cents when one can get $1.50 for the same animal in January." District number four, which is the smaller of the two districts paying bounty on muskrats, covers over 20,000 acres and has 133 miles of canals and waterways. In twelve months during 1919–20 this district, according to their secretary, paid a twenty-five cent bounty on 2395 muskrats. It is obvious that owing to the high prices of fur, nearly all of these muskrats would have been trapped, bounty or no bounty. One outstanding feature of muskrat control is seen in the fact that the market price is much more potent in the reduction of muskrats than the bounty system, and this is true even during years when fur is low in price. After careful investigation and consideration of all the factors concerned, it is believed by the writer that the value of the muskrats' pelts at least equals, and probably exceeds the damage done by these rodents in Imperial Valley.

The Imperial Valley pocket gopher constitutes the real rodent problem in the delta region. Fifteen years ago gophers occurred in very small numbers over small but widely scattered areas of the valley. This species was then so rare that museums had difficulty in securing even a few specimens. Today hundreds could be secured in almost any part of the irrigated sections. What has been the cause of this remarkable increase? The writer believes that the answer to this

question is irrigation and Bermuda grass. Under the original desert conditions food and ground suitable to burrow in were the chief factors that limited the distribution of the gopher.

Bermuda grass was abundant along the Colorado River near the intake of the main Imperial canal in 1910. This grass was carried all over the irrigated land by seed which was carried down stream by the irrigation waters. The banks of irrigation ditches afford safe breeding dens and temporary refuge to gophers. The root-stalks of the Bermuda grass, which flourishes along the margins of the canals, furnish these animals a constant, abundant, and acceptable food supply. The removal by man of many of the natural enemies of the gopher greatly improved the living conditions of these rodents, so that a larger percentage of the young reached maturity, and bred, thus hastening the rapid increase. While man has caused the death of many gophers through drowning, when the fields are flooded during irrigation, a large breeding stock always remains along the canal banks which are never flooded.

Gophers prefer to work in sandy soil. Hard or "tight" ground is avoided. This is well illustrated in districts seven and eight, both of which have a great deal of sandy ground and a corresponding abundance of gophers.

In district seven, 100 gophers have been trapped along one mile of canal in several places. In district eight, which is across the valley from district seven, there is a record of 400 gophers having been trapped in a short time along two miles of badly infested canal. Gophers are now also abundant along the main canals in Lower California. At Eastside and Sharp's headings they were found in March, 1921, to be present, as determined by actual trapping by the writer, at the rate of 105 per mile.

Gophers do not hesitate to invade fields adjoining the canals and here they destroy much alfalfa and other crops. If it were not for the fact that gophers are drowned out by flooding during irrigation they would soon become unendurable pests. There is no chance to starve out the gophers since they can always fall back on the Bermuda grass roots. The gophers often carry Bermuda grass root-stalks about in their cheek pouches and thus aid in the spread of this grass. About one-third of the gophers trapped by the writer at Eastside Heading in March, 1921, had Bermuda grass in their cheek pouches. All of the gophers thus caught were very fat, being fatter than the muskrats taken at the same time.

The breeding season of this gopher is long, extending over several months. According to professional gopher trappers two litters of young are frequently raised in one season. The average number per litter appears to be slightly less than six. As with the muskrats, the average litter is small in number, but this is more than compensated for by more than one litter being raised each season.

Unlike the muskrats, *gophers habitually burrow completely through the canal banks.* They usually keep just above the water line, but when the water in the canal is low the gophers also burrow low, and when the canal is again filled, the water leaks out through the gopher hole; this leakage, unless discovered and stopped in time, results in a break in the canal and in flooding of the surrounding fields. Gophers often burrow through the outside of the ditch banks and thus make connections with muskrat burrows, causing breaks in the canal for which the muskrat receives the blame. At the east end of the Encina flume which crosses New River below the line, gophers have riddled the inside of the main canal which at this point is merely a dirt embankment built up until the crest is nearly twenty feet above the surrounding territory. Gopher burrows in such places are exceedingly dangerous. One gopher at this point could easily endanger the growing crops on hundreds of acres in Imperial County. A narrow cement core built into the center of the canal banks could be cheaply installed at such points and would greatly reduce the danger.

Trapping and local or county bounties are the two control measures that have been most used against the gopher in this region. An officer of district eight reports that during four months in 1920–21 this district paid a bounty of twenty cents a scalp on nearly 15,000 gophers. Districts one and seven each employ two or more regular gopher catchers who are paid on a salary basis. These men trap faithfully and work where the gophers are doing the most damage, but the territory that each trapper can effectively cover is limited. The bounty system soon depletes the funds available and affords no permanent relief. Poisoning has been tried, but has met with poor success for the most part, due apparently to the abundance of food such as Bermuda grass which has been more acceptable to the gophers than the poisoned bait offered. Another difficulty is encountered in the fact that the water in the canals is used throughout the valley for domestic purposes and care must be taken that the water be not polluted by poison or by dead gophers. However, poison experiments which have already been carried on in the Imperial Valley, using a probe to locate the burrow and a bait

that is acceptable to the gopher, indicate that these rodents can be successfully poisoned. While pelts of beavers and muskrats are of considerable value, gopher pelts are worth nothing, and in the Imperial Valley these animals appear to be of no use whatever.

The rodent problems in the Imperial Valley are distinct from those that present themselves elsewhere in the state. Gopher control will be a hard fight in this section, growing harder and more expensive the longer it is put off. Any successful method of control must accord with the habits and food preference of this species, which at the present time are not well understood. A thorough study of the life history of this species should be made. The facts thus obtained, combined with actual field experiments in poisoning these rodents, would save thousands of dollars that are now being wasted in well meaning but ill-advised, unorganized, and wasteful attempts at control.

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A BROWN MUTATION IN THE OPOSSUM (DIDELPHIS VIRGINIANA) WITH REMARKS UPON THE GRAY AND THE BLACK PHASES IN THIS SPECIES[1]

By Carl Hartman

Through the courtesy of the United States Biological Survey and the United States National Museum I have been enabled to examine three brown specimens of opossums which clearly belong to the species *Didelphis virginiana*. The color of these is strikingly like the cinnamon colored mutant of the roof rat (*Rattus alexandrinus*) described by Patterson (1920) who thinks that this form may be analogous to the cinnamon mutation of the guinea pig described by Castle and Wright (1916). Like the cinnamon rat the brown opossums appeared in the wild; and since the opossum belongs to the order Marsupialia this report is not without genetic interest.

Before entering upon a detailed description of the new specimens it is necessary to recall the normal coat color of the opossum. Two phases, gray and black, have been described for the large North American opossums. In *D. marsupialis texensis* both phases are mentioned by

[1] Contribution No. 153, Zoological Laboratory, The University of Texas.

all authors, the black phase predominating (cf. Allen 1901, and Mearns, 1907). I have had about 20 specimens of this subspecies from San Benito, Cameron County; all of these were black.[2] For *D. virginiana*, however, Allen (1901) fails to mention the black phase, and one would gather from his monograph that none but the gray occurs in this species. Elliot (1901), however, had two blacks among his twelve Virginia opossums from Florida. In August, 1919, I saw a black of this species lying by the roadside near Oxford, Iowa. At Austin, Texas, the black phase of *virginiana* is found frequently. For example among the last 200 females of my records 15 are designated as "black"; but as the records were made for other than taxonomic purposes it is likely that several blacks escaped description in my notes. The percentage of blacks in central Texas is probably near ten per cent. From these facts it would appear that the black phase has received inadequate attention at the hands of mammalogists, although from the standpoint of genetics the blacks are of special significance.

The chief interest attaching to the black phase pertains to the independence of pigmentation of overhair and underfur. For it should be recalled that in grays and in blacks the underfur is alike, that is, it is white except for the black tip. The long, coarse overhair, however, is either white or black for its entire length on any given animal.[3] An animal is gray or black according to the color of the overhair. Some blacks have a few or even many white overhairs among the black, chiefly posteriorly; but there seems to be no intergrading series between the gray and the black phases. Dark gray specimens, for which Bangs (1898) attempted to set up a new subspecies (*D. virginiana pigra*), are often met with in this locality. No analysis of our dark grays has as yet been made, but they, too, are in a different class from the blacks.

Corresponding to these two normal phases of the opossum are the brown animals now to be described in which brown pigment has replaced black. Two specimens, skins Nos. 235543 and 235535, of the United States National Museum, Biological Survey Collection, were caught somewhere near Houstonia, Cooper County, Missouri, December, 1920, and were sent in by Dr. Chas. A. McNeill of Sedalia, Missouri, who states that according to information he has been able to gather

[2] It is possible that blacks only were selected for shipment and that these therefore do not represent random catches.

[3] The writer has among his notes a reference to a Virginia opossum having individual overhairs partly white and partly black. Such specimens must be very rare.

from animal dealers brown opossums are occasionally taken by hunters in Cooper County. The third skin examined is No. 19083 of the United States National Museum, received from Warsaw, Illinois, in 1890. The first is of the "all brown" variety, corresponding to the black phase; that is, all of the overhairs are brown except about a dozen white ones near the tail. It is darker than the other two, possibly approaching chocolate. The underfur is brown-tipped and brown pigment is seen in the skin of the snout and the scales on the proximal 40 mm. of the tail. The ears seem to be black. The other two specimens differ from the first in having the overhair white; in other words they correspond to the normal grays. All the specimens are large and have the extremely short tails characteristic of *D. virginiana*.

To summarize, then, four varieties of *D. virginiana* seem clearly differentiated:

1. The gray phase, with underfur black-tipped, overhair all white.
2. The black phase, with underfur also black-tipped, overhair altogether or for the most part black.

3 and 4. Like 1 and 2, with brown pigment replacing the black.

For an account of the occurrence of the brown mutation among mammals the reader is referred to Castle's book "Genetics and Eugenics" (1920) and to the several articles listed below. Recently Miller (1921) in this journal published a description of a brown mole, an insectivore; and with the present record the mutation is extended to the Marsupialia. This raises the question whether or not there is a very general distribution of the same factors involved in the development of coat color within the class Mammalia.

ADDENDUM.—Since sending the preceding article to the editor of the Journal the writer has been fortunate enough to secure from Doctor McNeill three additional specimens of the cinnamon opossum. They reached Austin, Texas, alive and in excellent condition from Sedalia, Missouri, where Doctor McNeill purchased them. Nothing else is known concerning their history. Of these three one enormous male and one two-year old female have white overhair; the third specimen is a yearling female without any white overhair whatever, that is, it is solid cinnamon. The feet and the base of the tail are brown. The ears are dark except for the unpigmented tip often seen in *virginiana* and *marsupialis*; but the pigmentation is light as compared with the black ears of the gray phase and tends toward brown, especially in the last mentioned individual. In this the ears are the lightest, and distinctly and unmistakably brown.

The iris of the eye was also examined in the three mutants as well as in the normal controls (grays). The iris is generally invisible, but in the bright sunlight it appears as a narrow marginal band. In the gray phase the iris is deeply pigmented, almost black; in the cinnamon mutants the iris is light, blending from the very light inner margin to a distinct brown at the periphery where it disappears under the eyelid.

All pigmented areas of the McNeill mutants, therefore (hair, scales of tail, ears and iris), have the brown color.

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NOTES ON EUROPEAN FOSSIL HORSES

By Ernst Schwarz

The problem of European fossil horses has always attracted the attention of zoölogists. Since the times of Cuvier, the subject has been treated by H. v. Meyer, Pomel, Rütimeyer, Owen, Major, Nehring, Woldrich, and many others and a great number of forms have been described, until, in 1886, Lydekker[1] provisionally grouped them under two headings: *Equus caballus* Linnæus, and *Equus stenonis* Cocchi. Thus matters stood when, in 1899, Boule,[2] in a most suggestive paper, pointed out that, in addition to these, a third species, *Equus robustus* Pomel, could be distinguished, which although approaching the *caballus* type, was, he thought, more nearly related to *stenonis*.

Since 1904 Professor Ewart[3] of Edinburgh has taken up the subject with a view to elucidating the origin of domestic horses. According to his theory[4] three types of domestic (and ancestral wild) horses can be distinguished; a "Plateau" variety including the Celtic pony and the Arab, which can be traced back to the Pliocene *Equus sivalensis*,[5] a "Forest" variety typified by the heavy draught horses of continental Europe and descended from Pomel's *Equus robustus*, and a "Steppe" variety still found in a wild state in Mongolia, *Equus przewalskii*, which has influenced some of the races of European cart-horses. Some more recent papers by Soergel,[6] Antonius,[7] and Boule[8] may be mentioned here; and finally an elaborate paper by v. Reichenau,[9] in which a number of new species and two new genera are described, which however has more confused than cleared the subject.

[1] Cat. Foss. Mamm. B. M., III, pp. 69–71, 73–88, (1886).

[2] Bull. Soc. Géol. France, (3) XXVII, pp. 531–42, text fig. 1–22, [1899] (March 1900).

[3] The most important of these papers are the following: Trans. Highl. Agric. Soc. Scotland, (5) XVI, pp. 230–268 (1904); Trans. Roy. Soc. Edinburgh, XLV, pp. 555–587 (1907); Science, (N.S.) XXX, pp. 219–223 (1909). Although I am compelled to state that his results are entirely wrong, yet I gladly admit that I owe many valuable suggestions to his papers.

[4] Similar views are held by Doctor Duerst (Carnegie Inst. Publ., no. 73, vol. 2, pp. 339–446; 1908).

[5] Or a nearly allied type which is called *Equus agilis* Ewart.

[6] Neues Jahrb. Min., Beilagebd. XXXII, pp. 740–761 (1911).

[7] Verh. k. k. zool. bot. Ges., LXII, pp. (64)–(78) (1912).

[8] Ann. Paléontol., V, pp. 113–135 (1910).

[9] Abh. Geol. Landesanst. Darmstadt, VII, pp. 1–155 (1915).

The evidence afforded by fossil bones and teeth found in Europe, Asia, and Africa appears to admit only two general types. In the species named *stenonis*, *atlanticus*, *persicus*, etc., the anterior pillar (protocone) of the premolars and molars is short (generally only one third of the total length of the tooth) with the anterior lobe scarcely developed and the interior margin mostly convex, straight or only slightly bent in at the middle. The enamel folds are moderately developed, the paracone and metacone are thick and their lateral surface convex, and the parastyle and mesostyle narrow and, if at all, only doubled in the anterior premolars. The eye sockets are somewhat projecting, and the angle of the lower jaw is deep. In the limbs the lower portions (radius-metacarpal and tibia-metatarsal) are comparatively long and narrow, the upper portions (humerus, femur) shorter than in the next species.[10]

In the other type to which such names as *caballus*, *plicidens*, *robustus*, *süssenbornensis*, *mosbachensis*, *przewalskii*, etc., have been applied, the anterior pillar of the cheek teeth is generally longer (usually more than one third of the total length of the tooth) with the posterior lobe always and the anterior one in many cases of considerable size, the interior margin being always bent in or even sharply divided at the middle. The enamel folds are more pronounced, the paracone and metacone distinctly lunate and their outer border concave, and the parastyle and mesostyle more imposing and doubled in most of the cheek teeth; the eye sockets are not projecting and the angle of the lower jaw is much less deep. The metatarsals and metacarpals are as a rule comparatively shorter and broader in specimens from older strata but about as slender as in the former species in more recent ones. The upper portions of the limbs (humerus, femur) are, however, somewhat longer compared to the lower portions (tibia, metatarsus, etc.).

It has hitherto been supposed that *Equus sivalensis* belongs to the first or *stenonis* type. But a renewed examination of Mr. Lydekker's beautiful plates[11] makes me believe that it is a member of the *caballus* series. The shape of the protocone, paracone and metacone and of the para- and mesostyle are decidedly of this type. This is still more so in *Equus namadicus* which is probably the direct descendant of *E. sivalensis* and apparently similar in the Ceylon tooth described by

[10] Lydekker, Guide to the specimens of the Horse family, p. 26 (1907).

[11] Mem. Geol. Surv. India (Palaeontologia Indica), (10) II, pl. XIV, XV (1882).

Wayland[12] as *Equus zeylanicus* and in *Equus leptostylus* Matsumoto[13] from Honan, China. Lydekker has made a strong case of the presence in *E. sivalensis*, *E. stenonis* and the Arab of a preorbital depression; but since the same character is found in the southern but not in the northern local races of *E. quagga*, I cannot regard it as of specific value.

It has frequently been maintained that the horses of the second (*caballus-robustus*) type were derived from those of the *stenonis* group, chiefly on the assumption (1) that *stenonis* is older (Pliocene) (2) that in some of the older specimens of "*robustus*" only a rather small protocone is found in the cheekteeth. This is disproved however by a tooth from the Red Crag of Bawdsey, Suffolk,[14] contemporaneous with or even older than *stenonis* and distinguishable, except in size, from the most recent teeth of *E. caballus* only in details discussed below. I am not quite satisfied whether the remains usually referred to *E. stenonis* and *robustus* respectively from the Oreston Cave near Plymouth, from Kent's Hole near Torquay, from the lower deposits at Mosbach near Wiesbaden, and from the older Auvergne strata are all found in the same horizon, but this is of little importance since the Bawdsey tooth[15] is older than either of them. There is no doubt, therefore, that both species occurred together in Europe during upper Pliocene and probably also basal Pleistocene times.

I shall now designate the first of these types as *Equus stenonis*. The names *atlanticus*, *ligeris*, *mauretanicus*, *persicus*[16] and *stenonis* decidedly belong to this species and may be races of it; their exact value and relation among each other I am not at present prepared to state. Remains of Pliocene age have been found at Maragha in northern Persia, in the Val d'Arno, Italy, at various localities in France, southern Germany, Austria-Hungary, and southern England; some, as those of Mosbach or the Norfolk Forest Beds as well as some of the British caverns, are early Pleistocene; the most recent materials appear to be those from northern Africa which have been described

[12] Spolia Zeylan., X, pp. 261–280 (1916); the tooth of *E. caballus* figured for comparison obviously belongs to an Indian domestic horse and is of the Arab or *stenonis* type.

[13] Science Reports of the Tôhoku Imperial University, Sendai, 2nd ser. (Geology), III, no. 1, pp. 29–30 (not seen in the original; figure copied by Wayland).

[14] Owen, Quart. Journ. Geol. Soc., XII, p. 223, fig. 12 (p. 233) (1856).

[15] The exact age of these strata is probably upper Pliocene.

[16] Wilckens, Anz. Ak. Wien, XXIV, p. 43 (1887), and Nov. Act. Leop., LII, p. 268, pls. XI, figs. 18, 19, X, figs. 21–24, XIII, figs. 43–46, XIV, figs. 47 (1887); from the lower or middle Pliocene of Maragha, Persia.

by Pomel, Ph. Thomas, Boule, and other French authors, and are in part from late Pleistocene deposits. There is, however, no doubt that everything found in continental Europe and especially in England is not more recent than early Pleistocene, about corresponding to the "first Interglacial" of Penck.

The modern Arab thoroughbred shows all the main characters of this type which have been pointed out above; in addition it possesses only five lumbar vertebræ, a feature not hitherto corroborated in fossil material, the available skeletons being of a very fragmentary nature. But there is ample reason to believe from the facts known that it is from this type that the Arab, Barb, and the high-bred "Oriental" races have been developed. Since it has been shown that *E. sivalensis* is distinct it becomes highly probable that the thoroughbred races have been bred from the North African race of *Equus stenonis* which in a wild state survived up to the human period.

The second type, which should be known as *Equus caballus*[17] (including a very great number of names the exact status of which is not yet determinable), first appears in the Pliocene Red Crag of England and the upper (upper Pliocene) deposits of the Sivalik Hills and is still found in a wild state in Mongolia. From the oldest to more recent forms a gradual decrease in size seems to exist which leads from the large tooth from the Red Crag figured by Owen as *E. plicidens* and the coarse limb bones mentioned by Lydekker[18] as belonging to a very large species, to the small light-limbed horses of late palæolithic and neolithic times and Przewalski's horse of Mongolia. It would appear that this evolution has not taken place in a continuous series in at least those parts of western Europe which underwent glaciation, had their fauna destroyed by the ice and only in "interglacial" and postglacial times regenerated from districts where it had been preserved. This assumption would explain the gaps between the large preglacial *E. c. plicidens*, the middle sized second stage (*E. c. robustus*) and the small third stage of the *E. c. spelæus-przewalskii* type. At present only in one case[19] have transitional stages been described, and these

[17] Fixed by Ewart (Trans. Highl. Agric. Soc. Scotland, (5) XVI, p. 264, on the Norwegian "Fjordhest." I cannot agree with Stejneger (Smith. Misc. Coll., XLVIII, p. 470; 1907) that Fitzinger (Ab. Ak. Wien, XXXI, pp. 139–212; 1858, XXXII, pp. 391–420; 1858, XXXV, pp. 335–36; 1859) should be regarded as first reviser, as he mixes up both types under his *E. caballus*.

[18] Cat. Foss. Mamm. B. M., III, p. 89 (1886); from the Norwich Crag.

[19] Soergel, l.c.; from Steinheim a.d. Murv, Württemberg.

are from an area which has remained free from ice during the whole Pleistocene. This gradual evolution may be observed in another important character; in the older forms the protocone of the cheek teeth is somewhat detached from the main body of the tooth and becomes more adpressed in more recent ones; the anterior lobe of the protocone is on the whole rather long and has been described as very characteristic of *E. c. przewalskii* by Lydekker;[20] it appears to be constantly so in the living and the more recent fossil forms, but in teeth which have been described from the lower Pleistocene of central Europe it is sometimes much smaller than the posterior lobe (from which it is generally clearly separated), though this is far from being constant, even in teeth from the same locality. The oldest tooth known (Bawdsey) is almost indistinguishable in this particular character from the most recent types.

It is this type, with a rather heavy head and six lumbar vertebræ, that has transmitted its principal characters to modern heavy races such as the "Pinzgauer" and "Belgian" draught horses. Their far superior size compared to that of the wild "tarpan" is most certainly the product of conscious breeding for certain purposes which has taken place in historical times and even within a rather short period. It has frequently been supposed that the most heavy types are derived from the middle sized horse of the "*robustus*" type, but this is impossible as that form had long ceased to exist at the time when horses were first domesticated. On the contrary all the available evidence afforded by fossil and prehistoric remains points to the fact that the most ancient domestic horses were of a type closely resembling the wild tarpan of Mongolia in their rather light build and somewhat clumsy head.

Professor Ewart believed that the "Celtic" pony is of another type than the tarpan. It has been already shown by Lydekker[21] that the skull characters adduced by him are not very reliable, and it has also been shown above that slender limbs are found in *E. stenonis* as well as in the more recent forms of the *caballus* type. It would further appear probable that the presence of only five lumbar vertebræ in some of the skeletons examined by Professor Ewart is due to infusion of southern blood;[22] I have ascertained[23] that the Lofoten pony preserved in the Bergen Museum and regarded as of pure Celtic origin

[20] Guide to the specimens of the Horse family, p. 14, fig. 16A (1907).

[21] "Guide," p. 15.

[22] Ridgeway, The Origin and Influence of the Thoroughbred Horse, pp. 419–420 (1905); and Lydekker, The Horse and its relatives, p. 121 (1912).

[23] With the kind help of Professor Brinkmann.

both by him and all those who have examined it, has six lumbar vertebræ. I should think that the original "Celtic" pony was of "northern" blood, and that the "southern" characters presented by a number of the present ponies are entirely due to mixture with horses imported from the Mediterranean region within historic times.

The remarkable fact that in Europe alone both species of horse were found together, will be understood by the following zoögeographical deductions. In the later Tertiary, Europe had a land connection with North Africa as well as western Asia, immigration being possible both from the East and South. Thus *Equus stenonis* reached Europe from northern Africa as a representative of the western or Mediterranean, *Equus caballus* from central Asia with the eastern or Asiatic component of the Pliocene steppe fauna. During the Glacial Period the greater part of both faunæ disappeared from central Europe. But when the ice had made its retreat, the Mediterranean landbridge was no longer in existence, and reimmigration was possible only from the East. In postglacial times *Equus caballus* ranged again all over northern and central Asia and the greater part of Europe and has given rise, through its various geographical subspecies, to the primitive domestic races of Russia and Asia and the heavy draught horses of western Europe. *Equus stenonis*, however, was held back in northern Africa where it has become the ancestor of the thoroughbred stock of Barbs and Arabs.[24]

Frankfort a. M., Germany.

[24] It is interesting to note here that a tooth from Wadi Halfa, Nubia, described by Lydekker (Quart. Journ. Geol. Soc., XLIII, pp. 161–63; (1887), as nearly related to *E. sivalensis*, appears to me quite different. If conclusions may be drawn from a single specimen, it seems to approach *E. quagga* more than anything else.

BATS FROM NEW MEXICO AND ARIZONA

By Glover M. Allen

Due to the generous interest of Col. John E. Thayer and Dr. Thomas Barbour, the Museum of Comparative Zoölogy has lately received a number of bats from New Mexico and Arizona a few notes on which seem worth recording. They were obtained chiefly by Messrs. Wharton Huber and R. D. Camp, the former while collecting in the vicinity of Las Cruces, New Mexico, for Colonel Thayer, and Mr. Camp during an expedition to the desert ranges of the Huachuca, Oro Blanco, Cayetano, and Patagonia Mountains of southeastern Arizona. The following ten species are represented.

Macrotus californicus Baird

CALIFORNIA LEAF-NOSED BAT

This species is well known to inhabit the hotter portions of southern California and Arizona. Rehn (1904) has recorded specimens from Tombstone, Arizona, and there is a specimen in the United States National Museum from near Tucson. The Camp collection contains fifteen of these bats, captured in a deserted mine tunnel, January 24, in the Cayetano Mountains, Arizona, at 4000 feet altitude. All but two were adult females. According to Mrs. Grinnell's observations in California, it seems likely that this species is somewhat migratory; at least, they withdraw in winter from certain localities where they were found in spring and summer. Two other specimens are from Superior, Arizona.

Chœronycteris mexicana Tschudi

LONG-NOSED BAT

An adult female secured by Mr. W. W. Brown in the Huachuca Mountains, September 27, 1920, is apparently the second specimen to be taken within the United States. The other record is of one captured in the Chiricahua Mountains, eight miles west of Paradise, Arizona, August 17, 1904 (see Miller, 1906). A comparison of our specimen with a female from Morelos, Mexico, reveals no important differences, though the skull of the former is a trifle the smaller. It is interesting in possessing on the right side of the upper jaw, a persistent milk tooth, directly behind and in contact with the canine. The

retention of this short recurved spicule is probably to be correlated with the length of jaws and the consequent uncrowded condition of the small teeth, thus allowing sufficient room to prevent the milk tooth from being pushed out.

Elliot in his Land and Sea Mammals of Middle America (1904) calls this the "Tres Marias Island Bat," but the supposed record for these islands turns out to be erroneous, as the species was really *Glossophaga mutica* (see Nelson, 1899, p. 14).

Myotis velifer (J. A. Allen)

CAVE BAT

Mr. Camp captured two males of this species on April 20 in Montezuma Cañon, Huachuca Mountains, at 6000 feet altitude.

Myotis occultus Hollister

HOLLISTER'S BAT

Hitherto this rare species has been found only on the west side of the Colorado River in extreme southeastern California. Hollister's two specimens were taken ten miles above Needles, San Bernardino County, May 14, 1905, and later, in May, 1910, six additional examples were collected by an expedition from the University of California. I have now to record it for the first time from New Mexico, where Mr. Huber obtained a female, May 23, 1920, three miles west of Las Cruces, on the Rio Grande. It was shot after dusk, as it flew through an orchard and under some large cottonwood trees. Two other bats, shot at the same time, and perhaps of the same species, could not be found. Dr. Joseph Grinnell, whose expedition obtained the six specimens noted above, suggests that this species is a late spring arrival in the region where it was found, since his party, "although collecting along the Colorado River from February 15 until May 15, failed to detect this bat until the first week in May." It will be seen that Mr. Huber's specimen was captured late in the same month, also. Perhaps it may be late in coming out of hibernation, rather than a late migrant from any considerable distance southward.

This species is remarkable among the North American *Myotis* in that the upper middle premolar (pm^3) is in process of becoming lost. According to Mrs. Grinnell (1918, p. 262), this tooth is absent from both sides of the upper jaw in four of the eight known specimens. In the

specimen from Las Cruces, however, it is absent on the left side only. Here the anterior premolar (pm^2) as if taking advantage of the loss of the middle one, is noticeably larger than the anterior premolar of the opposite side and stands fully in the tooth row so as to fill the space completely between canine and last premolar (pm^4). On the opposite (left) side, the anterior premolar lies just inside the axis of the tooth row, while the middle premolar (pm^3), much smaller, is forced even more inward.

This tendency to lose certain of the teeth is seen in many and very remotely related species of bats. It is not necessarily a result of the gradual shortening of the tooth row to produce greater crushing power for as in the Las Cruces specimen, the anterior premolar of the right side filled the space of two on the opposite side. The frequency with which the middle premolar is missing in this species indicates that the upper dentition is now in course of evolution from a three-premolar to a two-premolar stage. Apparently, to judge from the available specimens, the latter, more reduced condition has made such headway as to be now as frequent as the three-premolar stage. Should it eventually prevail within the species, the normal dentition would then have the same formula as in *Lasionycteris*, *Corynorhinus*, and certain other genera, so that it might come to be placed in a genus distinct from *Myotis*. Thus we may have in *Myotis occultus* a genus in the making, a species now referred unhesitatingly to *Myotis*, but which, if the loss of the middle premolar became permanent, would perhaps come to be regarded as a monotypic genus, characterized by its reduced dental formula.

Pipistrellus hesperus (H. Allen)

WESTERN BAT

This little whitish species with its black contrasting membranes, is confined more or less closely to the Great Basin. Although probably common locally, there is but one specimen in the collections here reported on, a male taken October 1, on the west side of the Organ Mountains, New Mexico, by W. Huber.

Eptesicus fuscus (Beauvois)

LARGE BROWN BAT

At Las Cruces, New Mexico, Mr. Huber found a considerable colony of this common and widespread species living in the roof of a building

where by a narrow crack they gained entrance to the space above the ceiling. Here, on June 28, he collected 23 specimens by dislodging them from their retreat. Of these, 15 were adult females, and the rest were well-grown young, probably at least a week or two old, the largest with short hair, and nearly a third adult size. Curiously, all but one of these eight young were males. The absence of adults of the latter sex may indicate that there is a segregation of the sexes at this season. A few were also found with a colony of free-tailed bats in a cave 15 miles northwest of Las Cruces, New Mexico, (opposite Shalem Colony). "The cave is about 50 feet deep by 30 feet wide, 16 or 18 feet high at the entrance, the roof sloping back to the floor in the rear. It is evidently of volcanic origin as the whole face of the hill is black and looks like lava. An arroyo rises at the entrance of the cave. The floor is covered with bat guano to the depth of a foot or more in places. Several of these bats were driven from crevices in the cave but managed to hide so that they could not be located again."

Sharing the cave with the brown and free-tailed bats, were ten pairs of cliff swallows with their mud nests attached to the ceiling near the entrance. A great horned owl was collected in the cave.

Nycteris cinerea (Beauvois)

HOARY BAT

Very little is definitely known of the breeding range of the hoary bat. In the eastern United States it is generally believed to be a migrant only; or from the Carolinas southward, a wintering species, breeding probably in Canada and perhaps the northernmost of the states. For California, however, Mrs. Grinnell (1918) supplies three July records out of a total of 55 for that State, and these three are all of adult males. In Mr. Huber's collection are two adult females which he found hanging in willows, five miles west of Las Cruces, New Mexico (3800 feet altitude), both on August 27, 1920. The discovery of two at the same locality on this date, suggests that they were early migrants just arrived from the northward. The same trees had been carefully searched for warblers the day before. Yet there is also some evidence that the species is present all summer in parts of the Southwest, for Mr. Camp's collection contains an alcoholic male from the Huachuca Mountains, taken June 26, at an elevation of 5200 feet. In addition, W. W. Price reported it "not uncommon" in the Huachuca Mountains during the

summer of 1893 (J. A. Allen, 1895, p. 247); and Attwater took one at Cubbra Springs, 18 miles west of San Antonio, Texas, in the early summer of 1891 (J. A. Allen, 1896, p. 71). I am unable to distinguish Camp's Huachuca specimen, or Huber's Las Cruces females, from others taken in eastern United States.

Corynorhinus rafinesquii pallescens Miller

PALLID LUMP-NOSED BAT

Colonies of these big-eared bats seem to be scattered and of relatively few individuals. Mr. Huber did not obtain the species at all during his stay of several months in New Mexico. In Arizona, however, Mr. W. W. Brown secured a female, September 30, in the Huachuca Mountains, and Mr. Camp collected fourteen of both sexes in the same range at different dates between March 28 and May 11, altitudes varying from 5200 to 7800 feet. Of twelve taken February 7, in the Oro Blanco Mountains, Arizona, (4600 feet) all but two were females. A similar disproportion of sexes in the colonies, one way or the other, is recorded by Mrs. Grinnell in her excellent summary of the habits of this species in California.

Antrozous pallidus (Le Conte)

PALLID BAT

In late July, Mr. Huber found well-grown young in colonies of this species at Las Cruces and Mesilla Park, New Mexico. At the former locality, five adult females and nine young were taken July 16 from behind the window casing of an abandoned sanitarium; and four days later at Mesilla Park, seven adult females and five young were captured from a colony of some 200, living in the spaces above the doors of an old alfalfa barn. The young bats were nearly full grown but in color the back is more dusky than in the adults, and the buffy tinge is lacking. The absence of adult males in the catch may indicate that they were keeping apart at this season. Mrs. Grinnell records a similar segregation on the part of the Pacific pallid bat in California. Mr. Huber also captured on June 8, at Bevino, an adult female, the only one apparently, in a large colony of free-tailed bats inhabiting a crevice above a barn door.

Nyctinomus mexicanus (Saussure)

MEXICAN FREE-TAILED BAT

This is probably the most abundant bat in the territory under consideration. As is well known, it is highly gregarious, living in colonies often of large size. So ready is it to take advantage of the shelter offered by human habitations, that colonies are more often found in the recesses of a roof than in caves, the primitive habitation. Mr. Huber discovered one cave fifteen miles northwest of Las Cruces, New Mexico, that was inhabited by this species. Twelve individuals taken at random here on June 2, proved to be all adult females, each with a good-sized fetus. At Bevino, there was a large colony living in the hollow space beneath a roof, entrance to which was gained through a crack over a door. Mr. Huber gathered 67 here on June 8, of which about one fourth were adult males, and the rest adult females, each containing a single fetus. In nearly every case the fetus was large and would probably have been mature in another week; a few, however, were smaller than the rest, while one or two were larger and seemed almost ready for extrusion. On the whole, however, the size of the embryos was rather uniform and indicates that in this colony at least, the breeding season is at a quite definite time. In most cases the fetus was carried transversely to the main axis of the body, with the head at the right-hand side, directed forward, and the little wings folded over the face.

The disproportionately small number of adult males seems typical of a breeding colony of this species. Mrs. Grinnell records a colony examined in San José, California, on February 2, in which the proportions of the sexes were about equal in clusters found behind the iron window shutters on the *west* side of a building; while on March 3, of 35 specimens from behind shutters on the *east* side of the same building all were females.

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THE VALIDITY OF THE PENOBSCOT FIELD MOUSE

BY LELAND C. WYMAN

In December, 1901, Mr. Reginald Heber Howe, Jr., described a new subspecies of *Microtus pennsylvanicus* which he had collected on Tumble Down Dick Island in Penobscot Bay, Maine, naming it *Microtus pennsylvanicus shattucki*.[1] There has been some doubt among mammalogists as to whether or not this form really differs from the ordinary meadow mouse of the mainland. Following are the results of a careful comparison of the type specimen and other skins of *M. p. shattucki* with about two-hundred skins of *Microtus pennsylvanicus* (Ord) in the collections of the Lee Museum of Bowdoin College, the Museum of Comparative Zoology of Harvard University, and various private collections. The specimens of *M. p. shattucki* which were examined consisted of the type and seven others of the original series from Tumble Down Dick and Ilesboro, Maine, now in the museum at Harvard and in the collection of the Boston Society of Natural History. These are the only specimens from the type locality which could be located. Others may exist in private collections. The specimens of *Microtus pennsylvanicus* used in the comparison were collected from four localities in Maine; three islands of the Maine coast; Grand Manan Island, New Brunswick; one other locality in Canada; three localities in New Hampshire; eleven localities in Massachussetts; seven islands near Cape Cod, Massachusetts; two localities in Rhode Island; one locality

[1] A New Race of Microtus pennsylvanicus. Reginald Heber Howe, Jr. Proc. Portland Soc. Nat. Hist., vol. 2, part 6, p. 201. Portland, Maine, December 31, 1901.

in New York; one in West Virginia; one in North Carolina; and (three topotypes) in Pennsylvania.[2]

The subspecific characters given in the description are: "One of the largest of the *Microtus pennsylvanicus* group. Tail very long, ears prominent, bullæ very large and globular, palatine foramina markedly broad and bottle shaped, coloration as in *M. p. pennsylvanicus*, except perhaps slightly darker." I shall take up these characters one by one.

SIZE

The description gives the total length of the new subspecies as ranging from 176 to 198 mm., and that of *M. pennsylvanicus* from 167 to 171 mm. (taking these measurements from Elliot's "Mammals of North America"). Although this is the average range of the length of the meadow mouse it is not uncommon to find specimens measuring from 170 to 200 mm. Of the measurements of the specimens examined, 11.3 per cent of the whole number were between 190 and 200 mm., 20 per cent were between 180 and 190 mm., and 28.8 per cent were between 170 and 180 mm. The remaining 40 per cent were below 170 mm. Two specimens from Massachusetts and one from Raleigh, North Carolina, were over 200 mm. in length. The total lengths of the eight specimens of *M. p. shattucki*, taken from Howe's measurements, were 138.4 mm. (2), 165.1 mm. (2), 168.1 mm., 187.5 mm., 190.5 mm. (type), and 201.5 mm. With the exception of two specimens these measurements are well within the average range for *pennsylvanicus*. Meadow mice from the islands off the New England coast are large as a rule. The series from Grand Manan, New Brunswick, which I examined were at the upper limit for the size of the species.

EARS

It is difficult to tell much about the ears of dried skins, owing to their shrunken condition. Those of the skins of *M. p. shattucki* did not appear to be any different from those of skins of meadow mice from a great variety of localities. Five of the specimens were collected in July, one in August, and one in September. In summer pelage the ears of meadow mice are usually conspicuous above the fur, so this fact may account for the statement that the ears are prominent. Such a char-

[2] I am indebted to Prof. Manton Copeland of Bowdoin College for suggesting the comparison and to Dr. Glover M. Allen of Harvard University for the loan of skins and skulls.

acter should not bear much weight in an animal as variable in minor details as the meadow mouse.

COLORATION

The color of the meadow mouse is due to a mixture of yellowish rusty and blackish hairs, the relative abundance of which determines the particular shade. In a large series of meadow mice there is a great variety of fine gradations of color from very pale, yellowish specimens to those which are dark brown or blackish. Many from the mainland of New England are almost black in color. The series of *M. p. shattucki*, when compared with a series of three hundred skins from a great variety of localities, were seen to be in about the middle of the range of color variation. They are rather bright with a large proportion of yellow and reddish hairs, being almost identical in color with specimens from various localities in Massachusetts, and distinctly lighter than many others also from Massachusetts.

AUDITAL BULLÆ

Upon superficial examination there appears to be no noticeable difference between the bullæ of the skulls from Tumble Down Dick and of those collected in various places in New England. A skull from Wareham, Massachusetts, was seen to be almost an exact match in every particular for the skull of the type specimen of *M. p. shattucki*. The skulls of the series from Grand Manan are comparatively large and heavy and the bullæ are large in proportion, appearing to be more globular than those of *shattucki*. For purposes of comparison the greatest length and the greatest width of the right bullæ of the seven skulls of *shattucki* and of ninety-six skulls of *pennsylvanicus* were measured to the nearest hundredth of a millimeter by means of calipers and a micrometer. The dimensions of the bullæ of *shattucki* ranged from 7.32 by 5.75 to 8.85 by 6.63 mm. Those of *pennsylvanicus* run up to 9.41 by 7.00 mm. The average dimensions of the right bullæ of fifteen specimens from Grand Manan is 8.53 by 6.43 mm. In order to obtain a quantitative expression of the globularity of the bullæ, the width was subtracted from the length in each case, and the result was divided by the length. This gave an index of the ovalness of the bulla which would be smaller in the case of more globular and larger in the case of less globular bullæ. The indices thus obtained were grouped into nine magnitude classes and the classes were numbered in order. Class

4 contained the greatest number of variates, thus being the mode. The indices of three of the specimens of *shattucki* fall into this class, three into class 5 and one falls into class 6. This constitutes quantitative proof that the audital bullæ of *M. p. shattucki* are not more globular than the average bullæ of *M. pennsylvanicus*.

PALATINE FORAMINA

The palatine foramina of meadow mice vary greatly in size and shape. Many are seen in skulls collected from various places which appear to be as broad as or broader than those of *M. p. shattucki*, especially in large skulls such as those of the Grand Manan series. The length and greatest width of the palatine foramina of eight skulls of *shattucki* and of 103 skulls of *pennsylvanicus* were measured with calipers. The dimensions of those of *shattucki* range from 4.57 by 1.35 to 6.10 by 1.56 mm. The width of the foramina of *pennsylvanicus* run up to 1.79 mm. The average dimensions of the Grand Manan series are 5.89 by 1.52 mm. The expression "bottle shaped" is an obscure one to deal with quantitatively. This character may best be expressed as an index by dividing the length by the greatest width, giving a number which would be smaller in the case of more bottle shaped foramina. This was done for each specimen measured and the results were grouped into eleven magnitude classes, class 5 constituting the mode. Of the indices of *M. p. shattucki*, three fall into the mode, three into class 6 and one each into classes 3 and 4, proving quantitatively that the palatine foramina of *shattucki* are not broader in proportion to their length than the average foramina of meadow mice, and hence cannot be considered more bottle shaped.

TAIL LENGTH

The tail length of the new subspecies is described as ranging from 54 to 62 mm., while the average range of tail length of meadow mice is given as from 44 to 46 mm. The recorded measurements, taken in the flesh, of 186 specimens of meadow mice range from 30 to 60 mm. The tail lengths given in the records with the skins of *M. p. shattucki* fall well within this range with the exception of two specimens, both of which are recorded as 63.5 mm. It is not uncommon to find meadow mice with tail length well up to 60 mm., and where only two specimens range slightly above this, it seems hardly plausible to base a subspecies on such a character. There is a possibility, also, that the records on

the labels are not correct. The tails of the skins of *shattucki* were measured with calipers and found to be from 6.1 to 17.8 mm. shorter than the recorded measurements. Of course it is impossible to say anything about the dimensions of an animal in the flesh from measurements of the dried skin, but as a rule the technique of skinning causes the tail to be stretched if anything. To test this the tails of 80 skins made up by a number of different collectors were measured and compared with the measurements of the same animals taken in the flesh. In 50 per cent of the cases the tails were from 0.5 to 13 mm. longer than the lengths recorded and in 12 per cent they were the same. It does not seem probable that the tails of the *shattucki* series would have shrunken so consistently.

CONCLUSION

The comparison described above showed no essential differences between the Penobscot field mouse and the common meadow mouse of the mainland. In all of the characters mentioned in the description as being subspecific, the specimens of the *shattucki* series lie within the range for *Microtus pennsylvanicus*. In view of the constantly increasing complexity of the classification of mammals it would seem well to exclude the subspecies *shattucki* from a revised list of species in the genus *Microtus*.

Boston, Mass.

THE EVOLUTIONARY FORCE OF A WIDE RANGE

By Ernest Thompson Seton

(It is with considerable hesitation that I offer this paper on a subject that is somewhat out of my usual line. I do so on the advice of my friend, Dr. Joseph Grinnell, of Berkeley, California, as he assures me it will be found new and important, and that I should certainly put it on record.)

In 1892, I corresponded with a Russian naturalist, Baron Max von Sivers, of Roemershof, Riga, Livonia, who represented a group that intended to introduce the wild turkey into Livonia. Though in sympathy with their purpose, I took a pessimistic view of its feasibility, and, in a brief paper, pointed out a principle involved that seems nearly self-evident when one arrays the available facts.

This principle I have often referred to in my writings since, and elaborated in my lectures, but have not hitherto offered for record in formal scientific print. Therefore I now reproduce that paper.

The theory is briefly this: *Other things equal, a species evolved in a large area, is stronger than one evolved in a small area.* Obviously, the chances of superior variants appearing are greater in a large population than in a small one. And further, a race that can adapt itself to the many vicissitudes of a large range is stronger than one that is fitted to the less vicissitudes of a more limited space. Evidently a big fire is hotter in the middle than a little fire.

The largest existing land-area, for a species that can freely traverse mountains and rivers, is Eurasia. Therefore, if my theory be right, a Eurasian species will speedily overcome an American species, or an Australian species. Witness the triumphant march of the house-sparrow, the starling, the brown rat, the house-mouse, the mongoose, the fruitbat, the carp, the brown trout, the browntail and the gypy-moths, etc., many weeds and even trees.

These, being Eurasian, have been specialized in so many ways, and hardened in so many more fires and forces than our own kindred species, that they are stronger, hardier, more adaptive, less subject to disease, more resistant, more aggressive, more frugal, more prolific. And they march ever on, possessing and destroying, even as the white man himself has done. Significant illustration is seen in the facts that the Asiatic chestnut is immune to the blight that is destroying the American, and the Caucasian pine is proof against the blister-rust that is filling American foresters with dismay.

All attempts to implant our ruffed grouse in the old world have been utter failures; on the other hand the Hungarian partridge and the Mongolian pheasants are immediately successful here.

Not only is a species of Eurasian evolution stronger than one of American; but an American is stronger than an Australian; an Australian is stronger than a New Zealander; and an African is stronger than a Madagascan species. Indeed, a continental species always is stronger and bigger than an insular form; and creatures evolved in small islands wither away before the invading Eurasians like pine boughs in a flame. For example, note the dodo of the Mauritius, and the ground-pigeon of Samoa, and possibly also our own wild pigeon.

It seems to be nearly self-evident that all of the dominating land animals in North America today are of species that have close kin, and apparently their parent stock, in Eurasia. They probably invaded this area by way of the northwest land-bridge; for example, the coyote, gray-wolf, fox, mountain-sheep, moose, white bear, otter, weasel. And the species that cannot hold their own, as attested by paleontology, were those evolved in this region.

It is pretty well established that as a rule species increase in size as they evolve, and are at their maximum when their race disappears, i.e., great size is proof that they have gone far along the trail.

This rule is evidenced by the fact that the recent or living American cats, camels, horse, sheep, bison, wild hogs, horned owl, ostrich, etc., are smaller than those of the older, bigger world.

If however the giant fox of South America is of the genus *Vulpes*, then it is an exception to the rule I am trying to formulate. If it is obviously of another genus, it is not an exception, and further foreshadows with certainty the finding of extinct giant foxes in Eurasia. The same remarks and prophecy apply to the condor and the harpy eagle.

If we compare the gerboas of Africa with the nearly parallel kangaroo-rats of America, we find that the former, with their wide range, have gone much further in evolution than the latter with their limited range. I doubt not that a few thousand African gerboas released in our southwest would, by mere pressure of better equipment, drive all our dipodomyids to extinction, and possess their range.

Conversely, no American species has ever been able to establish itself in Eurasia, no Australian species has ever conquered Eurasia or America, no New Zealand species has ever successfully invaded

Australia, no species of Madagascan evolution, has ever established itself in Africa.

My sad contention, then, to my Russian friends, was that the American wild turkey would stand no chance of success if introduced into a Eurasian environment, to compete with the highly equipped native species.

As apparent exceptions one recalls the canal weed, (*Philotria canadensis*), an American species running riot in England; the water hyacinth of South America becoming a nuisance in Florida; maybe also the muskrat which is said to be possessing parts of Europe.

I suppose that the answer is that the rival species these invaders must combat in their new homes, were evolved in small, isolated sections of their larger motherland, in some way hedged about by an impassable barrier. They had not really a continent-wide dispersal, so were not subject to the urge of a wide environment, and, therefore, are not exceptions to the principle of the law.

The great land centre of evolution is Eurasia, and it will continue to turn out the successful species, as long as it continues to be the greatest unbroken land area, a thought that is not without its measure of warning to the human species, when one recalls that, in a rigid application of this law, the Oriental races are bound to inherit the earth.

Greenwich, Connecticut.

HABITS OF SOME WEST COAST SEALS

By A. Brazier Howell

Recently, I had occasion to look up information on certain seals in the classical works by Scammon and Allen and I find that some notes I have on the habits of two of our southern California species may prove of interest.

Practically all of my notes on the pinnipeds were made before I took an active interest in mammals, but I had some little opportunity to become familair with them, for, while working in 1910 with the International Fisheries Company in Lower California, Mexico, I spent two months, with a dozen Yaqui Indians, on Los Coronados Islands. Seals of two species were abundant, and as our constant diet of fish and spiny lobsters soon palled, we began weekly visits to the rookeries to obtain fat yearlings. In addition, I made many other trips to the different islands, and spent many an hour watching the herds from hidden retreats.

The California sea lion (*Zalophus californianus*) is abundant in the coastal waters of southern California, but to me, it has always seemed a sluggish, rather uninteresting animal which hardly repays protracted watching. An hour or two spent in a rookery will reveal little but basking animals, some occasionally slipping into or out of the water, and the proper complement of pups nosing about in a stupid manner. On June 3, 1910, the pups—two score of them—were a week or more old and when we suddenly rushed the colony to obtain a yearling before he could slip into the water, the younger animals were not greatly concerned as long as we approached no nearer than about fifteen feet. They presented, when beating a retreat, a most ludicrous appearance, for their efforts were out of all proportion to the speed attained, and they worked so hard, and progressed so slowly, that they seemed almost to be jumping up and down in one spot. When we laid hold of one, it emitted a loud, staccato bleating, comparable to the noise made by certain exotic goats which I have heard in zoological parks. The pups readily take to the water at this age, but their swimming is poor and their actions in this direction quite similar to those when "running" on land. In fact, it was so apparent that immersion in a rough sea at such a tender age must prove fatal to many, that we molested them as little as possible thereafter. While we were in the rookery, the females exhibited considerable anxiety, racing back and

forth at a distance of a hundred yards from shore and frequently leaping entirely out of the water in graceful curves.

The killer whale (probably *Orcinus ater*) is not rare in these waters and must take considerable toll of the seals. I also suspect the huge sharks, locally known as "leopard sharks," of a similar dietary taste. It is said that these big fellows, appearing to be at least eighteen feet long in some cases, are transient visitors from the south, and spend a week or more in the cold waters about the islands in order to free themselves of certain parasites. I can answer to the fact that they furnish rare sport with the harpoon.

At occasional spots on the islands, there occur caves which are popularly known as blow-holes. The entrances to these are chiefly below water, but, at certain stages of the tides, the top of the entrance is above water in the trough of a swell, and below at the crest. When the latter condition obtains, there is considerable pressure exerted upon the air in the cave, and this rushes forth through the wave with a booming noise, sending the spray high in the air—at one spot of which I know, as high as fifty feet when the trades are blowing strong and causing large swells. California sea lions delight to enter these caves to bark for half an hour at a time, and the resultant racket produces some weird accoustic effects.

The Yaquis, being pearl divers from the Gulf of California, were almost amphibious themselves, and constantly slipped over the sides of their cumbersome canoes, dug from a single log, to investigate the bottom for signs of spiny lobsters and fish. On two such occasions, the men were approached by seals, which exhibited the greatest astonishment and curiosity at finding such strange creatures in the water.

The California harbor seal (*Phoca richardii geronimensis*) is found about the islands, but in far smaller numbers than its larger relative, and the two genera apparently shun each other. In a shallow, rocky cove on the seaward side of the larger middle island of Los Coronados group, there is a hauling-out ground where about twenty-five of these animals could usually be found, and I spent considerable time in their company. A favorite position for them, and one which would seem to be the height of discomfort, was on a little pinnacle of rock, not over a foot in diameter at the top, and this was rarely unoccupied except at high tide. A seal would balance on this amidships, with every evidence of extreme satisfaction, head hunched in as when resting, fore flippers close to his sides, and rear ones extended straight out behind. There he would stay until dislodged by a companion or

washed off by the rising tide. He would remain just as long as he was able, and as the tide rose and each wave snatched at him, he would jerk both extremities of his body as far from the water as possible, looking like some queer, animated toy.

I was lucky enough, one day, to surprise five or six yearlings in a large, isolated tide pool that was a veritable gem of a sea garden. Here I kept them for ten or fifteen minutes while I watched their graceful movements. They swam at relatively great speed near the bottom of the pool, rolling their large eyes at me and dodging when I waved my arms. I was surprised to find that they did not use the fore flippers when swimming but kept these closely pressed to the sides, while the hind ones, placed "palm to palm," were moved rhythmically from side to side after the manner of a fish's tail, and furnished the sole means of propulsion. When a quick turn was desired, however, a fore flipper was extended and literally pushed against the water, as a running child might push with his hand against a wall to make a quick dodge. When pressed for air they arose to the surface for an instant, and then submerged with the celerity of a grebe. One dashed from the pool and made for the sea, but became wedged between two rocks, where I promptly laid hold of his rear flippers and, with considerable difficulty, hauled him forth. But he did not play fair, for he ejected a vile, excrementitious brew upon me, whereupon I incontinently released him and departed elsewhere.

These animals are much more wary than their larger cousins, and, at least when on the alert, they have a curious mode of submerging. While I was watching the individuals in the pool the remainder of the animals were a short distance off shore in a great state of excitement. Each one at times rose high out of the water, "stood" straight up, stared a moment, and then, by violently slapping one flipper on the surface, and probably raising the other through the water at the same time, submerged sideways as quick as a flash.

The above observations on the harbor seals were made on, or prior to, June 22; and at that date no young pups were in evidence.

Pasadena, California.

REMARKABLE CHANGES IN THE SKULL OF AN AMERICAN BADGER (TAXIDEA TAXUS) DUE TO ADVANCED AGE

By Dr. R. W. Shufeldt

[*Plate 10*]

While recently engaged in comparing the skulls of certain American mustelines and one from Hungary, namely the skull of a specimen of the European badger (*Meles meles*), with the view of preparing a brief monograph on the subject, I met with the skull of an American badger among the material kindly loaned me by the United States National Museum for this purpose, which seems to be worthy of special description. This skull is numbered 22253, but carries no data on its attached label beyond the statement that it is the skull of a specimen of *Meles taxus*. If *Meles taxus* stands for the European badger, this diagnosis is an error, as the skull is from an aged specimen of an American badger —*Taxidea taxus*. Each and all of its characters have been compared by me with the corresponding ones as presented in the skull of a very large American badger and the aforesaid skull of the European species (*Meles meles*), No. 171964, Hungary Acad., C. Jones.

The skull from the American one belonged to a very large specimen collected by W. S. Wood on the Republican Fork of the Platte River, on the 28th of September, 1856 (227), and carries the number of the National Museum of 2572 (♂). Beyond the loss of the left hamular process of the post palatine, it appears to be perfect in all particulars. As in a number of our mustelines, when they grow old, the mandible is nearly permanently locked to the cranium at either of its articulations,—that is, by the anterior and posterior articular eminences of the glenoid fossæ of the temporals at the posterior termination of either zygomatic arch. This locking, which is complete in many instances, occurs in various species, or rather in the skulls of old animals of our American forms, and has long been known; but whether it is ever seen in the skulls of badgers of the Old World I am not informed, though I am inclined to believe that it does not. It is not seen in the skull of *Meles meles* at hand, which came from an animal long adult.

Turning to the skull here to be compared and described, it is found to have an extreme length of 12 cms., and an extreme width (interzygomatic) of 8 cms., as compared with the skull No. 2572, which presents corresponding measurements of 12.3 cms. and 8.3 cms. The European badger (No. 171964) possesses a long and narrow skull

having an extreme length of 12.3 cms. and a width of only 6.3 cms. In general form, measurements, and facies, it has more the appearance of the skull of a very large Marten (*Martes americana*) than that of our badger, and it will not be further considered in the present connection, as its full description will appear later on, when the characters of all the skulls of the mustelines at hand will be described.

Passing now to the skull of the aged badger, it is first to be noted that the external surfaces of the cranium and mandible have a roughish feel and fine, porous appearance in some places, more particularly on the bones of the face and over the parietal region.

Viewed upon its superior aspect, the cerebral casket of the cranium is more or less globular in form, the two superficies being separated by a very prominent, mesial sagittal crest of bone, the superior rim of which is more or less thickened. The crest averages a centimeter in height for its posterior moiety, tapering away as we pass forward, to run out as raised rims limiting the temporal fossæ anteriorly (fig. 1).

Turning to the badger skull No. 2572 (fig. 2), this crest is seen to have an average height of hardly more than a millimeter; while its anterior branches, limiting the temporal fossa upon either side, are practically flush with the general surface of the cranium. In this badger, instead of being globular in form, the vault of the cranium has an outline of an isosceles triangle, its broad base being the raised rim of the occipital crest. The middle point of this crest is triangularly indented, while its lateral terminations are curved, causing their surfaces to face forwards and upwards. The extreme width at this point measures 8.2 cms. All this is entirely different in the cranium of our aged badger, wherein the occipital crest, though prominent, is low down on the cranium, circular in outline, and terminating on either side just below the osseous auricular opening. The occipital area below this crest is much limited in extent; concave supermesially, and terminating in a sharp, thin, concave edge as the superior margin of the very large foramen magnum.

In the American badger the occipital region is very extensive, being perpendicular to the longitudinal axis of the cranium, and reniform in outline—the large foramen magnum being in the center, below, and the superior elliptical curve being formed by the limiting occipital crest. These parts in the crania of the two animals present such wide differences in the matter of characters that, were there naught else to go by, the mammalogist that placed the individuals exemplifying them in different families would probably be sustained by his confrères.

SKULLS OF BADGERS

FIG. 1. Skull of a very old American Badger (*Taxidea taxus*) seen on right lateral view; mandible articulated; natural size. FIG. 2. Same view, natural size, of the skull of an adult specimen of the American Badger (*Taxidea taxus*), No. 2572, Coll. U. S. Nat. Museum.

(Shufeldt—Skull of Badger.)

Viewed upon its facial aspect, the cranium of this old badger presents the usual musteline characters of its genus. The infraorbital foramen is large and of different outline in the two skulls here being compared, as in the aged badger its outer arc is curved, to be angulated in the larger skull.

Upon anterior view, the narial aperture is always seen to be large and oval in outline in a badger, the long axis being mesial and vertical. The ethmoidal bones are extremely complicated and spongy, extending far forwards in this aged badger, and being far back in the skull here shown in figure 2. *Vomer* is to some extent incomplete.

One of the best evidences of great age in the skull here being described is the condition of its dental armature, most of the incisor teeth being lost, others broken, and the remainder all worn—worn down to an extent never before observed by me in any ferine mammal. As these teeth stand, however, it is very evident that, in the matter of the formula, they agreed originally with that of *Taxidea taxus*.

Beyond the extraordinary wearing away of the teeth, the *mandible* of our subject essentially agrees in all of its characters with what we find in the lower jaw of our common badger—the position and number of foramina having no weight. It is not permanently locked at its articulations in the glenoid fossæ. Beyond the evidences of great age, the characters seen at the *basis cranii* are typically taxidean, an apparent shrinkage of the *auditory bullæ* alone constituting any marked difference.

Washington, D. C.

BEDS OF THE GORILLA AND CHIMPANZEE

By C. R. Aschemeier

During my stay of over two years in the Gaboon District, French Congo, I was much interested in the sleeping nests or "beds" of the gorilla and the chimpanzee; and it was my good fortune to find numbers of these beds belonging to each species. Both animals, according to my observations, make their beds in as secure places as they can find, but the chimpanzee seems to favor the greatest retirement, with less chance of disturbance from its foes of the jungle. I did not see a single bed of the chimpanzee on the ground, and they were usually constructed well up in the fork or crotch of tall and quite slender trees. In no case was the nest of the chimpanzee constructed in a tree measuring over a foot and a half in diameter at the base; and the trees selected were with few branches, a good distance apart. The lowest chimpanzee bed noted was about 30 feet from the ground, and the highest (two beds here quite close together) was fully 60 feet up.

Not long after my arrival at Omboue, Fernan Vaz, from Cap Lopez, and while still a bit "green," I went into the bush a short distance, accompanied by a native boy as a guide, to look for specimens. After we had wandered about for quite a long time and had secured a few birds, my companion suddenly stopped and gazed into the upper part of a tree. I could not at first see anything and asked what was there. He replied "N'chigo anago," and as I was still new to the language I was inclined to let it go at that, but he finally managed to make me understand what he meant—a chimpanzee bed or house. He then climbed up and investigated, and when he came down I ascended. I was quite played out by the time I reached the bed, but I examined it as well as I could, with one arm free to investigate. It was in a crotch of the tree and was well made of leaves from the same tree together with what looked like parts of bushes from off the ground. From what I have learned in regard to the bed of the orang-utan, I should judge that the nests of these two apes are very similar. I wondered, and have since often been asked, if the chimpanzee uses the bed more than once. Reliable natives all agreed in saying that the same beds are never twice used.

Later on I was collecting in the bush one day when, as it was getting quite late, I decided to return to camp. I had with me at the time my most faithful and efficient guide and helper, Pambo, who suddenly stopped short in his tracks. On looking up I saw three dark forms

in a tree, and these proved to be chimpanzees preparing a bed. I was very anxious to see more of the work, but the animals unfortunately saw us and hastily started to descend. At least one of them, I was sure, was not doing any of the work and the impression I got was that it was "bossing the job." This one was the last of the three to start down the tree, and as I was able to shoot it, I found it to be a male of the type known to the natives as "koola-kamba."

The chimpanzee beds later discovered were all very much of the style of the first ones examined. The chimpanzees were usually up and about at the break of day, and were in their beds, or near them, as a rule, by sundown or shortly after.

The beds of the gorilla I found to be much more variable. Some were similar to those of the chimpanzee, but the natives always knew the difference, and if the nest had been used the night before I myself could easily tell what the occupants were. The gorilla has an odor almost as characteristic and prominent as its teriffic yell. To describe this odor is quite impossible. It is pungent, and smells a bit like rubber. Often while walking along we would suddenly detect the odor of the gorilla, and on investigation find where the animals had passed or had stopped to eat.

Another style of the gorilla bed is an oblong affair on the ground, composed of bushes, grasses, and ferns. While it is not made as a man would make a similar bed, still, on seeing it, one could not say that it was not a good job. Still another type of the gorilla sleeping quarters is that where nests are made by bending and breaking saplings so that three or four will come together at the tops, thus forming a fair bed. The trees are not broken off entirely, but, about midway, just enough so they will stay down. One of the most interesting features about the beds of the gorilla is that they are made in close proximity to streams of water, where mosquitoes and insects of many kinds are particularly abundant. Perhaps the gorilla knows that other dwellers of the jungle will not stay in such places.

The natives tell me that some old male gorillas stay by themselves, and that these solitary males are the ones that use the oblong ground nests and the beds formed by the bent over saplings. The tree nests are used by the gorilla families; the old female together with the young reposes in the tree and the old male of the family sits at the base with his back leaning against it, on the lookout for his enemy the leopard. This is one of the habits that shows the great courage of the gorilla; I was told of one encounter, to the death of both, between a gorilla

and a leopard. Sometimes I saw where the male had wandered a short distance from the tree in the early morning to gather the itando plant and fruit, the hulls of which were at the base of the tree beneath the nest.

The gorilla usually left his bed shortly after daybreak in the morning; but on several occasions I surprised families, evidently "sleepy-heads," in bed an hour or two after break of day. These usually waited until we got very close to the beds and then gave out their disconcerting yells and made off. By dusk the gorillas were all in the beds.

U. S. National Museum, Washington, D. C.

DIAGNOSES OF SEVEN NEW CHIPMUNKS OF THE GENUS EUTAMIAS, WITH A LIST OF THE AMERICAN SPECIES

By Arthur H. Howell

Recent studies of the North American chipmunks, based on the extensive series in the Biological Survey collection, supplemented by a large amount of material loaned by other museums, have revealed the existence of a number of unrecognized forms and have resulted in a much clearer conception of the relationships of the various forms.

Since publication of the complete results of these studies may necessarily be delayed for some time, it is deemed wise to publish now preliminary descriptions of the new forms and a list of the species grouped to show their relationships.

Eutamias minimus arizonensis subsp. nov.

Type.—No. 205,869, U. S. National Museum (Biological Survey collection); male adult, skin and skull; from the Prieto Plateau at the south end of Blue Range, Greenlee County, Arizona; collected September 7, 1914, by E. G. Holt; original number 384.

Subspecific characters.—Similar in size and cranial characters to *Eutamias minimus atristriatus;* nearest in color to *E. minimus consobrinus*, but general tone more grayish (less tawny), the shoulders frequently washed with pale smoke gray (as in *Eutamias cinereicollis*); tail more bushy and color of under surface brighter tawny (about as in *operarius*).

Measurements of type.—Total length, 197; tail vertebræ, 87; hind foot, 30; ear from notch, 12. *Skull:* Greatest length, 32.6; zygomatic breadth, 18; mastoidal breadth, 14.5; interorbital breadth, 7.1; length of nasals, 10.1.

Remarks.—This race of the least chipmunk is restricted, so far as known, to the White Mountains and Prieto Plateau of eastern Arizona. It occurs over a

part of the range of *Eutamias cinereicollis* and so closely resembles that species in color that it has until recently escaped recognition. The sides are slightly paler and the nose less heavily washed with clay color than in *cinereicollis*, but in all other markings the resemblance between the two species is remarkable. However, *arizonensis* is decidedly smaller, with much shorter ears and hind feet, while the skull closely resembles that of *atristriatus*, and is widely different in size and proportions from that of *cinereicollis*.

Eutamias amœnus vallicola subsp. nov.

Type.—No. 168,027, U. S. National Museum (Biological Survey collection); female adult, skin and skull; from Bass Creek, near Stevensville, Montana (altitude 3,725 feet); collected March 23, 1910, by Clarence Birdseye; original number 1052.

Subspecific characters.—Similar to *Eutamias amœnus luteiventris*, but averaging paler throughout, especially the head, upper parts of body, and under surface of tail.

Measurements of type.—Total length, 223; tail vertebræ, 102; hind foot, 32.5; ear from notch, 14. *Skull:* Greatest length, 33.6; zygomatic breadth, 18.8; mastoidal breadth, 15; interorbital breadth, 7.5; length of nasals, 11.3.

Remarks.—This subspecies is apparently confined to the Bitterroot Valley and the adjacent foothills, but the exact limits of its range are not known. Twenty-six specimens from the valley, representing both winter and summer pelage, have been examined.

Eutamias ruficaudus simulans subsp. nov.

Type.—No. $\frac{28487}{40591}$, U. S. National Museum (Biological Survey collection); female adult, skin and skull; from Cœur d'Alene, Idaho; collected June 1, 1891, by Clark P. Streator; original number 881.

Subspecific characters.—Similar to *Eutamias ruficaudus ruficaudus*, but color of sides, under surface of tail, and tail edgings paler; skull with relatively broad braincase and rostrum.

Measurements of type.—Total length, 248; tail vertebræ, 117; hind foot, 33; ear from notch, 14. *Skull:* Greatest length, 35; zygomatic breadth, 19.3; mastoidal breadth, 15.8; interorbital breadth, 7.8; length of nasals, 12.1.

Remarks.—This race of the rufous-tailed chipmunk occupies the mountains of northwestern Montana (west of the main divide), northern Idaho, northeastern Washington, and southeastern British Columbia. It bears a rather striking resemblance to *Eutamias amœnus felix* of the coast region of British Columbia, but may be distinguished from that species by its slightly larger skull, longer and slightly paler tail, whiter underparts, paler sides of body and face, and more tawny head.

Eutamias bulleri solivagus subsp. nov.

Type.—No. 116,882, U. S. National Museum (Biological Survey collection); female adult, skin and skull; from Sierra Guadalupe, Coahuila, Mexico; collected May 1, 1902, by E. W. Nelson and E. A. Goldman; original number 15,169.

Subspecific characters.—Similar to *Eutamias bulleri bulleri*, but sides slightly darker; head slightly paler (more grayish); tail darker beneath and edged with a darker shade of buff; hind foot shorter; skull smaller.

Measurements of type.—Total length, 234; tail vertebræ, 108; hind foot, 35; ear from notch, 17. *Skull:* Greatest length, 36.6; zygomatic breadth, 19.5; mastoidal breadth, 15.8; interorbital breadth, 8.3; length of nasals, 12.1.

Remarks.—This race apparently is confined to an isolated mountain range in southern Coahuila. It resembles typical *bulleri* in color, but is readily distinguished by the darker color of the under side of the tail. In this character it resembles *durangæ*, but differs from that race in the absence of a buffy wash on the upper parts.

Eutamias speciosus sequoiensis subsp. nov.

Type.—No. $\frac{30899}{42799}$, U. S. National Museum (Biological Survey collection); female adult, skin and skull; from Mineral King, east fork of Kaweah River, California (altitude 7,300 feet); collected September 12, 1891, by Vernon Bailey; original number 3259.

Subspecific characters.—Similar to *Eutamias speciosus frater*, but upperparts averaging slightly darker, the median pair of dorsal stripes less whitish and more mixed with cinnamon; tail and ears averaging slightly longer; tail much darker beneath, edged with a paler shade of buff, and with a greater amount of black at the tip. Compared with *speciosus:* Upper parts more brownish and less grayish in general tone, the median pair of dorsal stripes more mixed with cinnamon; rump and hind feet more buffy (less grayish); tail decidedly longer. Compared with *callipeplus:* Upperparts and sides more extensively tawny, the median pair of dorsal stripes less whitish; shoulders darker; tail with much greater amount of black at the tip; hind feet, ears, and tail longer.

Measurements of type.—Total length, 241; tail vertebræ, 114; hind foot, 36; ear from notch, 18.1. *Skull:* Greatest length, 36.8; zygomatic breadth, 19.4; mastoidal breadth, 14.9; interorbital breadth, 8.2; length of nasals, 12.5.

Remarks.—The sequoia chipmunk ranges on the upper slopes of the southern Sierra Nevada from San Joaquin River south to Tule River and east to Mt. Whitney and Olancha Peak. Doctor Merriam referred the series from "the eastern crest of the High Sierra from Olancha Peak and Mount Whitney northward" to *speciosus*, and the series from "the western slope of the Sierra from the headwaters of Tule River northward nearly to the Yosemite Valley" to *callipeplus*.[1] With a much larger series than was then available, I can detect no constant differences between these two colonies, but as a whole they show marked differences from all the other races, as pointed out above.

Eutamias townsendii siskiyou subsp. nov.

Type.—No. 161,033, U. S. National Museum (Biological Survey collection); female adult, skin and skull; from near summit of White Mountain, Siskiyou

[1] Merriam, C. Hart, Proc. Biol. Soc. Washington, vol. 11, pp. 200, 202, 1897.

Mountains, California (altitude 6,000 feet); collected September 16, 1909, by N. Hollister; original number 3432.

Subspecific characters.—Nearest to *Eutamias townsendii senex*, from which it differs in darker coloration of the upperparts and sides, the rump and thighs especially being much more brownish (less grayish). Compared with *ochrogenys:* Coloration much more grayish (less brownish); light dorsal stripes grayish white instead of tawny-olive; sides of head and face much less ochraceous; underparts more whitish and only faintly washed with pinkish buff; tail paler beneath; skull similar to that of *ochrogenys*, but averaging smaller.

Measurements of type.—Total length, 268; tail vertebræ, 104; hind foot, 36.5; ear from notch, 15.5. *Skull:* Greatest length, 38.5; zygomatic breadth, 21.4; mastoidal breadth, 16.4; interorbital breadth, 8.2; length of nasals, 12.3.

Remarks.—The Siskiyou chipmunk occupies the Siskiyou Mountain region of northern California and southern Oregon, ranging north to the upper Rogue River Valley, Oregon. It is, of course, intermediate in characters between *senex* and *ochrogenys*, but has well defined characters distinguishing it from either and occupies an area of considerable breadth.

Eutamias townsendii alleni[2] subsp. nov.

MARIN CHIPMUNK

Tamias townsendii hindsii ALLEN, Bull. Amer. Mus. Nat. Hist., vol. 3, p. 75, 1890, and of recent authors generally (not *Tamias hindsii* Gray).

Type specimen.—No. 135,177, U. S. Nat. Mus. (Biological Survey collection); male adult, skin and skull; from Inverness, Marin County, California; collected November 16, 1904, by N. Hollister; original number, 1378.

Geographic distribution.—Coast region of Marin County, California, from Point Reyes east to Mount Tamalpais.[3]

Subspecific characters.—Similar to *E. townsendii sonomæ* but slightly smaller; head and upperparts distinctly darker in both pelages; outer pair of light dorsal stripes usually strongly washed with buff; underparts averaging more buffy (less whitish); hind feet darker; tail averaging darker beneath; skull similar to that of *sonomæ* but averaging smaller. Compared with *E townsendii ochrogenys:* Size much smaller; upperparts much brighter tawny (less olivaceous), especially in winter pelage; dorsal stripes more distinct, the dark stripes much more blackish, the light stripes more buffy; sides of face less extensively washed with ochraceous.

Measurements of type.—Total length, 231; tail vertebræ, 105; hind foot, 37; ear from notch, 16. *Skull:* Greatest length, 36.8; zygomatic breadth, 19.6; mastoidal breadth, 15.1; interorbital breadth, 7.8; length of nasals, 10.5.

Remarks.—This is a renaming of the form currently known as *Eutamias hindsii*, which name now proves to be a pure synonym of *E. townsendii townsendii*.

Inquiry of Mr. Oldfield Thomas regarding the type specimen of *Tamias hindsii* developed the fact that it is in the British Museum (No. 42.10.30.10). On the

[2] Named for the late Doctor J. A. Allen, the first reviser of the chipmunks of this genus.

[3] Cf. Grinnell, J., Univ. Calif. Pub. Zool., vol. 12, p. 324, 1915.

assumption that this type was collected near San Francisco, California (cf. Allen, Bull. Amer. Mus. Nat. Hist., vol. 3, p. 77, 1890), specimens representing the three forms occurring in that general region—*pricei*, *sonomæ*, and *"hindsii"*—were sent to Mr. Thomas, who kindly compared them with the type of *hindsii* only to find that the latter agreed with none of them but was closely matched by specimens of *townsendii* from British Columbia.

The type specimen of *hindsii* was taken by Capt. Edward Belcher on the voyage of the *Sulphur* but the exact locality whence it came is unknown. The original label and the British Museum register credit it to "California," a name loosely applied in those days to the greater part of the Pacific coast of the United States. We learn from the narrative of the voyage of the *Sulphur* that the vessel put in at a number of ports on that coast, from Nootka Sound, British Columbia, to Magdalena Bay, Lower California and that collections were made in the vicinity of San Francisco and on the Sacramento River, also in the vicinity of Fort Vancouver, near the mouth of the Columbia River. In view of the positive indentification of the type with the species inhabiting the latter region it seems most probable that the specimen was taken at or near Fort Vancouver.

Mr. Thomas's identification of the type with *Eutamias townsendii* is confirmed by an examination of the colored plate in "The Zoology of the Voyage of H. M. S. Sulphur," which certainly resembles *townsendii* much more nearly than it does the form from Marin County, California, which has for many years been known under the name *E. hindsii*. The original description, also, though inadequate, fits certain specimens of *townsendii* without violence and in the mention of white underparts agrees with *townsendii* rather than with the California form. Mr. Thomas is of the opinion that the inscription "near San Francisco" was written on the type label at a later date by someone in the British Museum—evidently however, without authority for the statement.

Doctor Allen in his revision of the genus in 1890, attempted to define the type locality in the following words: *"Tamias hindsii* was originally based on a specimen almost unquestionably taken in the immediate vicinity of San Francisco, California, in the month of November."[4] That this assumption, however, is unwarranted is shown by the facts already cited.

Since *Eutamias hindsii* now becomes a synonym of *E. townsendii townsendii*, the form from Marin County, California currently known as *"hindsii"* must be provided with a new name, and it is a pleasure, therefore, to name it in honor of the late Dr. J. A. Allen.

REMARKS ON THE NOMENCLATURE OF EUTAMIAS

The last revision of the entire group was that of Allen, in 1890, in which 23 forms were recognized.[5] Merriam, in 1897, published a synopsis of the Pacific Coast forms, with a revision of the *townsendii* and *speciosus* groups.[6] Since the time of Allen's revision the material

[4] Allen, J. A., Bull. Amer. Mus. Nat. Hist., vol. 3, p. 77.

[5] Allen, J. A., op. cit., pp. 45–116, 1890.

[6] Merriam, C. Hart, Proc. Biol. Soc. Washington, vol. 11, pp. 189–212, 1897.

available for study has vastly increased[7] and the number of recognized forms has more than doubled; our knowledge of the distribution of the various species has of course likewise extended, but in the absence of a monograph of the group, the relationships of the species are not well understood and many forms in current nomenclature are wrongly assigned.

Much of this confusion is due to the erroneous identification by the earlier revisers of *Eutamias quadrivittatus* (the first member of the genus to be named) and their failure to recognize the distinction between the races of *Eutamias amœnus* and of *E. minimus*—two distinct species whose ranges overlap in several regions, and certain forms of which greatly resemble one another. Doctor Merriam, in 1905, showed conclusively that the name *quadrivittatus* applies to the larger of the two species occurring together in the mountains of Colorado and in the same paper named the smaller form (then currently confused with *quadrivittatus*) *E. amœnus operarius*.[8] He did not, however, attempt a revision of these two groups, and a more detailed study of the relationships of *operarius* shows it to be a subspecies of *Eutamias minimus* rather than of *E. amœnus*.

LIST OF RECOGNIZED AMERICAN FORMS OF EUTAMIAS, WITH SYNONYMS[9]

Eutamias alpinus[10]

EUTAMIAS MINIMUS GROUP

Eutamias minimus minimus (Bachman)
Eutamias minimus pictus (Allen)
Tamias minimus melanurus Merriam
Eutamias minimus caryi Merriam
Eutamias minimus pallidus (Allen)
Eutamias minimus cacodemus Cary
Eutamias minimus consobrinus (Allen)
Eutamias lectus Allen
Eutamias consobrinus clarus Bailey
Eutamias minimus operarius Merriam
Eutamias minimus atristriatus Bailey
Eutamias minimus arizonensis, nobis
Eutamias minimus oreocetes Merriam
Eutamias minimus borealis (Allen)

[7] Dr. Allen based his review on about 650 specimens, while the present writer has examined more than 10,000.

[8] Merriam, C. Hart, Proc. Biol. Soc. Washington, vol. 18, pp. 163–164, 1905.

[9] Synonyms in italics.

[10] This species apparently is not closely related to any other.

Eutamias minimus caniceps Osgood
Eutamias minimus neglectus (Allen)

EUTAMIAS AMŒNUS GROUP

Eutamias amœnus amœnus (Allen)
Eutamias amœnus propinquus Anthony
Eutamias amœnus monoensis Storer & Grinnell
Eutamias amœnus luteiventris (Allen)
Eutamias amœnus vallicola, nobis
Eutamias amœnus canicaudus Merriam
Eutamias amœnus affinis (Allen)
Eutamias amœnus ludibundus Hollister
Eutamias amœnus felix (Rhoads)
Eutamias amœnus caurinus Merriam
Eutamias panamintinus (Merriam)

EUTAMIAS QUADRIVITTATUS GROUP

Eutamias quadrivittatus quadrivittatus (Say)
Tamias quadrivittatus gracilis Allen
Eutamias quadrivittatus animosus Warren
Eutamias quadrivittatus hopiensis Merriam
Eutamias umbrinus (Allen)
Eutamias adsitus Allen
Eutamias ruficaudus ruficaudus Howell
Eutamias ruficaudus simulans, nobis
Eutamias cinereicollis cinereicollis (Allen)
Eutamias cinereicollis cinereus Bailey
Eutamias cinereicollis canipes Bailey
Eutamias bulleri bulleri (Allen)
Eutamias bulleri durangæ Allen
Tamias nexus Elliot
Eutamias bulleri solivagus, nobis
Eutamias speciosus speciosus (Merriam)
Eutamias speciosus callipeplus (Merriam)
Eutamias speciosus sequoiensis, nobis
Eutamias speciosus inyoensis Merriam
Eutamias speciosus frater (Allen)
Eutamias palmeri Merriam

EUTAMIAS TOWNSENDII GROUP

Eutamias townsendii townsendii (Bachman)
Tamias hindsii Gray
Tamias townsendii littoralis Elliot
Eutamias townsendii cooperi (Baird)
Eutamias townsendii ochrogenys Merriam
Eutamias townsendii siskiyou, nobis
Eutamias townsendii senex (Allen)
Eutamias townsendii sonomæ Grinnell
Eutamias townsendii alleni, nobis
Eutamias quadrimaculatus (Gray)
Tamias macrorhabdotes Merriam

Eutamias merriami merriami (Allen)
Eutamias merriami mariposæ Grinnell
Eutamias merriami pricei (Allen)
Eutamias merriami kernensis Storer & Grinnell
Eutamias merriami obscurus (Allen)
Eutamias merriami meridionalis Nelson & Goldman
Eutamias dorsalis dorsalis (Baird)
Eutamias canescens Allen
Eutamias dorsalis utahensis Merriam

Biological Survey, Washington, D. C.

GENERAL NOTES

HOARY BAT IN VERMONT

A live male specimen of the hoary bat (*Nycteris cinerea*) was picked up on the sidewalk at Woodstock, Vermont, June 20, 1921, and was presented to the writer for his private collection. This bat seems to be rare in Vermont in the breeding season although it must occur here during migrations. The only other specimen recorded as captured within the state was taken at Colchester, on Lake Champlain, October 12, 1842, and is now in the State museum at Montpelier. The writer and friends have watched for the hoary bat many evenings along mountain streams and lakes without success. On October 29, 1921, a large bat was seen flying over the marshes on a mountain lake in Wallingford, altitude 2300 feet. It was not shot as it would have been lost in the swale. The temperature had been below freezing on several occasions, and there was ice in some places when this bat was seen. The writer judged that none but a hoary bat would have showed the hardihood to be abroad at such a time.—GEORGE L. KIRK, *Rutland, Vt.*

AN INSTANCE OF UNPROVOKED ATTACK BY A BROWN BEAR

On August 25, 1921, I killed a moose while hunting on the headwaters of Sidney Creek, a tributary of the Nisutlin River, in Yukon Territory, Canada, and after butchering the same, returned to camp late in the evening.

The following morning Mr. W. E. Rumble, his son Willard Rumble and myself, taking two dogs with us, left for the scene of the kill with the intention of bringing in the meat for camp use. The moose was killed in a fairly dense thicket of willows and upon nearing the spot where the carcass was located I pushed on ahead of my companions, who were followed by the two dogs, until I was perhaps fifty or sixty feet ahead of them, entering the thicket by way of a narrow game trail. I had progressed only a short distance into the thicket when I heard a crashing in the underbrush, followed by an exclamation from one of my companions, and upon looking back, beheld a medium size brown bear charging directly toward them along the edge of the thicket. Mr. Rumble was armed with a Winchester repeating rifle, but before he could throw a load into the chamber and shoot, the dogs had rushed out at the bear and he then withheld

his fire for fear of hitting one of them. The charge of the bear had brought it to within ten feet of the Rumbles when diverted by the dogs, one of which it chased into the brush and then turned and repeated the performance with the second dog. When the bear stopped this time it was standing broadside to me just at the entrance of the game trail in which I was standing and about twenty feet distant from me. I was armed with a 7 mm. Mauser rifle and when I first saw the bear, I had, as I supposed, thrown a cartridge from the magazine into the chamber, but evidently had failed to bring the bolt back far enough to engage the shell and consequently the rifle was unloaded. Up to this point I do not think that the bear had seen me, but when my rifle snapped it turned and charged upon me, covering the intervening distance in two jumps, the first of which brought it to within six or eight feet of the spot upon which I was standing. Loading as hastily as possible, I fired and dropped to the ground, at the same time throwing up my arms to protect my face from injury. The bear had sprung at me before I fired and when I dropped, the momentum of the leap carried it clear over me, but it struck at me as I was falling and tore quite a large gash in my left forearm with one claw. By this time the dogs had recovered their morale and chased the bear into a thick clump of brush where they bayed it. My shot had evidently wounded the animal quite severely for it had spilled a large quantity of blood where it struck the ground just over my head. We immediately followed to the place where the bear had stopped and after a short time shot it in the head, but not until after it had caught one of the dogs, which had ventured too close, and given it a severe mauling. Subsequent examination showed that my first shot had penetrated the animal's heart, and although it apparently had made it quite sick, it was fully two or three minutes before it was finally dispatched by a head shot. The bear was a female weighing about six hundred pounds.

Upon going to the spot where the moose carcass had been left we discovered that the bear, after sampling each of the quarters, had dragged them together and covered the lot with dirt and moss. We returned shortly to camp, a distance of eight or nine miles, but were prevented from immediately revisiting the scene of the encounter by a spell of rainy weather that lasted five days. The bear evidently had a young one with her, for upon returning to the place after the weather had moderated, we could observe evidence that a cub had tried to suckle her.

I wish to emphasize the fact that this attack was entirely unprovoked. When the bear attacked us we were at least fifty yards from the moose carcass and, owing to the thick growth of brush intervening, were not visible from that spot. The dogs were behind Mr. Rumble and his son until the bear had almost reached them and could not possibly have provoked the attack.—A. C. Bonebrake, *Goldendale, Wash.*

A COYOTE IN MARYLAND

On February 5, 1921, an adult male coyote was shot 5 miles northwest of Poolesville, Montgomery County, Maryland, by Mr. John A. Jones. The animal had been seen by several people in the region at various times since early in the winter, but it had successfully evaded guns. Its chances of living were lessened,

however, when it became friendly with a female Airedale dog, lost some of its wariness, and frequently came near the farm buildings where the dog lived. It was killed with a shot gun in a field on the farm.

Mr. Jones has generously deposited the skin and skull in the Biological Survey collection, United States National Museum, where the specimen becomes number 235,503. It may be tentatively referred to *Canis latrans latrans*, but with our present confused knowledge of the taxonomic relations of the coyotes exact identification of individual specimens is almost impossible. The animal was adult, but not old, the teeth showing only a trace of wear. It differs in no pronounced color or cranial characteristics from a male specimen collected in May, 1910, at Rockford, Iowa, which may be considered typical *latrans*.

The question naturally arises as to how a coyote reached this eastern locality. It is, of course, impossible to say definitely. The animal probably escaped from captivity. Or it may represent an extreme easterly extension of the geographic range of coyotes. There is no direct evidence for or against either of the suppositions. It is known that the range of the coyote has gradually extended northward and eastward, but it would seem hardly probable that the species has, as yet, ingressed a region as far east as central Maryland.—Hartley H. T. Jackson, *U. S. Biological Survey, Washington, D. C.*

AN OBSERVATION ON THE CARNIVOROUS PROPENSITIES OF THE GRAY GOPHER

While on a camping trip in northern Minnesota during August I chanced to make an interesting observation on the preying habits of the gray gopher, *Citellus franklini* (Sabine). On this particular occasion our party had stopped for lunch in a vacant yard in the forest of western Aitkin County. Suddenly we heard sharp squeals coming from the edge of a copse and looking in that direction we noticed what appeared to be a struggle going on in the grass. Hurrying to the spot we discovered a nearly full-grown gray gopher struggling with a young rabbit which it had seized behind the right ear. The gopher hesitated a moment on our approach, but did not release its grip until I stepped to within a pace of it, when it darted off a distance of two or three feet. The rabbit, I observed, was alive but unable to move. It was fully as large as the gopher. We stood still and the gopher returned to the attack, biting the rabbit furiously about the body. Again I frightened the gopher away but it returned once more to the attack and repeated its previous performance. I frightened it away a third time, but again it returned and rushed upon the prey biting it here and there about the body until it was apparently dead. Then running its nose rapidly over the carcass the gopher began gnawing at the hind quarters.

We left the scene and about twenty minutes later I returned to the spot and found the gopher still gnawing at the carcass, the hind quarters of which, except for skin and bones, had been devoured. Examining the spot where the struggle was first seen I found a small "form," in which the rabbit had apparently been lying when it was pounced upon. A week or so previous to this occasion, at Gull Lake in Crow Wing County, I watched an individual of this same species making after a striped gopher, which, however, escaped into a brush-pile.—Arthur M. Johnson, *Department of Botany, University of Minnesota.*

THE YOUNG OF THE CALIFORNIA GRAY SQUIRREL

The large arboreal nests of the California gray squirrel (*Sciurus griseus griseus* Ord) are not uncommon in the Transition Zone forests of California but the finding of young in one of these nests is a rather unusual event. In fact, I have not been able to find any published account of the young of this species except general statements relative to the number to a litter and approximate season at which they are dropped.

On April 13, 1919, while in the hills near Lake Lagunitas, Marin County, California, I examined a number of arboreal nests of mammals. Some of these were the work of the brown-footed woodrat, but the majority of those investigated had been made by gray squirrels as attested by their smaller and more rounded form, more compact structure, and greater height above the ground. In the Sierra Nevada nests of the gray squirrel are more often placed in conifers, but in the coast redwood belt the animals use the live oak, California laurel, and madrone. The nest discussed here was about 40 feet above the ground in a live oak, just within the crown of green leaves at the top of the tree. It came to attention only when the tree was examined from directly beneath. The nest tree was in a grove of live oaks on a slight rise of ground between two rather level small valleys.

This nest was about 50 centimeters in outside diameter. The form of the base of the nest suggested that it might originally have been constructed by a western crow, a bird which is common in many parts of Marin County. There were portions of several flight feathers of a crow in the nest but these could well have been picked up on the ground by the parent squirrel when gathering material for the nest lining. The central soft portion of the nest was about 25 centimeters in diameter. At the bottom it was made up of shredded oak bark prepared by the parent squirrel in the manner common to many rodents, and much of this material was in very short lengths. Above this was a soft mass of gray lichen, chiefly *Usnea florida* but with some *Evernia prunastri* and a slight amount of a moss, *Alsia longipes*. Over the moss and lichen were some live oak twigs cut green to which the leaves were still adhering. In the central soft part of the nest were the two young squirrels where they could easily keep warm while the female was away.

The young squirrels were packed in an "egg" box and taken to Berkeley where they were kept alive for a few days, being sheltered in a box lined with cotton. They were fed on "Carnation" condensed milk, diluted with three parts of water. This diet was obviously unsuitable as it caused a violent digestive disturbance, more or less constipation, followed by a profuse diarrhea, and so weakened the young that they had to be killed and preserved as specimens. Upon autopsy of one of the squirrels the caecum was found to contain much caseated milk and to be bloated with gas. Possibly cow's milk would have been more suitable. Instances have been reported where a cat whose young have been removed has acted as foster parent for young squirrels. Great difficulty was experienced in keeping the young squirrels sufficiently warm.

When the nest was first opened a finger thrust at the young squirrels was eagerly seized and sucked—an obvious feeding reflex. Later, in captivity, whenever they were touched, their forefeet would work around and eagerly

grasp a person's hand. On the evening of capture, warm diluted "Carnation" milk was offered in a glass medicine dropper. Little was taken then, but the next day they fed five times, and at one feeding each took about 10 cubic centimeters of the milk. The following day they were fed four times at intervals of approximately four hours, taking about the same amount at each feeding. Similar feeding was carried on for two days more but by the fifth day they showed little desire to feed, and their weakened condition caused abandonment of further attempts to keep them alive. Often a finger wet with milk would be seized and sucked on eagerly until all the milk had been drawn in. The tongue was held in a broad U-shape when sucking.

When feeding, the young pushed outwardly with their fore feet, and they suckled the medicine dropper contentedly only when their feet found a surface against which they could press. Presumably when feeding normally they massage the mammary glands of the female as do the young of domesticated animals. They squirmed a good deal while feeding but more than once upon having their hunger satisfied they fell asleep before being put away. Between feedings the young spent practically all of their time asleep. When first taken they twitched and twisted while asleep but this was less evident as they grew larger. When asleep they curled up with the nose toward the lower part of the abdomen and often with one hind leg thrown over the head. The young uttered low squealing sounds when taken from the nest and later, in captivity, especially if they became cold.

When first seen the skin of the young squirrels was loose and wrinkled. Three days afterward their bodies had filled out so that this condition had entirely disappeared. The hair, which at first was but a slight growth on the dorsal surface, had in the same period of time grown rapidly, and the white lateral fringing of the tail began to show. A brown spot appeared at the inner base of each ear and the black ended overhairs on the dorsum showed conspicuously. But there was only a very slight growth of hair on the belly during this time. The whole appearance of the young was substantially changed during this interval. When found, the disproportionate size of the head and feet suggested the young of a carnivorous mammal. This changed to a typical squirrel appearance within three days.

At no time were the eyes open, although to judge from their growth in captivity the squirrels must have been more than a week old when found. Forty-eight hours after being collected the male weighed 74.6 grams and measured (approximately) 205 × 93 × 34 × 8 millimeters. Three days later he measured 220 × 100 × 35 × 8. The female weighed and measured at the same time, was 80.4 grams and measured 225 × 95 × 37 × 8. Similarly, when prepared as a specimen, she measured 240 × 102 × 40 × —. Weights were not taken subsequently as the animals were much reduced by their enteritis and weights then would not have been significant.—Tracy I. Storer, *Museum of Vertebrate Zoology, University of California, Berkeley, Calif.*

RECENT LITERATURE

Hornaday, William T. THE MINDS AND MANNERS OF WILD ANIMALS. A BOOK OF PERSONAL OBSERVATIONS. New York: Charles Scribner's Sons. Pp. i–x, 1–328, illust. $2.50. May, 1922.

The Minds and Manners of Wild Animals is "a book of personal observations" by one who has given sixty years to the sympathetic study of the creatures about which he writes. The result is a remarkably interesting description of the behavior of a wide variety of vertebrates under various conditions in nature or in captivity. Quotations are notably few in number. The author well proves the truth of his assertion that "To the inquirer who enters the field of animal thought with an open mind, and free from the trammels of egotism and fear regarding man's place in nature, this study will prove an endless succession of surprises and delights." Every page bears witness to this fact. Doctor Hornaday has not allowed his interest and enthusiasm to run away with his common sense and good judgment. He keeps in mind his own dictum that "In studying the wild-animal mind, the boundary line between Reality and Dreamland is mighty easy to cross. He who yields to seductive reasoning, and the call of the wild imagination, soon will become a dreamer of dreams and a seer of visions of things that never occurred. The temptation to place upon simple acts of animals the most complex and far-fetched interpretations is a trap ever ready for the feet of the unwary. It is better to see nothing than to see a lot of things that are not true." . . . . "The student must not deceive himself by overestimating mental values. If an estimate must be made, make it under the mark of truth rather than above it. While avoiding the folly of idealism, we also must shun the ways of the narrow mind, and the eyes that refuse to see the truth. Wild animals are not superhuman demigods of wisdom; but neither are they idiots, unable to reason from cause to effect along the simple lines that vitally affect their existence." . . . . "Brain-owning wild animals are not mere machines of flesh and blood, set a-going by the accident of birth, and running for life on the narrow-gauge railway of Heredity. . . . . Some animals have more intelligence than some men; and some have far better morals."

The long-debated question of the reasoning power of animals is answered by Hornaday in a very positive manner. He says: "Yes. Animals do reason. If any one truth has come out of all the critical or uncritical study of the animal mind that has been going on for two centuries, it is this. Animals do reason; they have always reasoned, and as long as animals live they never will cease to reason." And again, "The wild animal must think, or die."

The book as a whole is divided into four sections. First, there is "A Survey of the Field" in which, following certain introductory statements and generalizations, there is a discussion of the temperament and individuality of wild animals, in which temperament is subdivided into six types, "the morose, lymphatic, sanguine, nervous, hysterical, and combative," and a comparatively long list of the larger mammals is given under these heads. The language of animals is discussed in a chapter which covers a range from frogs to primates. As language, the author considers four sorts, vocal, pictured, written, and sign. "The higher wild animals express their thoughts and feelings usually by sign language, and rarely by vocal sounds. Their power of expression varies species by species, or

tribe by tribe, quite as it does among the races and tribes of men." In his discussion of "The Most Intelligent Animals," Hornaday concludes that "the Chimpanzee is the most intelligent of all animals below man," though his account of the famous gorilla, John Daniel, leaves the reviewer in doubt as to whether, at least in that individual case, the palm should not have been awarded to the gorilla. The orang is put second and the elephant third. The remarkable manifestations of intelligence in the horse and dog are ascribed to their long association with man. "The Beaver manifests, in domestic economy, more intelligence, mechanical skill, and reasoning power than any other wild animal."

The chapter on "The Rights of Wild Animals" sounds the note so often and so forcibly presented in the previous works of the author. He pleads that "toward wild life, our highest duty is to be sane and sensible, in order to be just, and to promote the greatest good for the greatest number." The chapter concludes with twenty-six articles of "The Wild Animals' Bill of Rights."

The second section of the book is entitled "Mental Traits of Wild Animals," and includes discussions of "The Brightest Minds among American Animals," wherein "the prize for greatest cunning and foresight in self-preservation" is awarded to the common brown rat. "The championship for keen strategy in self-preservation belongs to the musk-oxen for their wolf-proof circle of heads and horns." The wolverine is considered to display the greatest cunning, with the gray wolf and the grizzly bear not far behind. "Among the hoofed and horned animals of North America the white-tailed deer is the shrewdest in the recognition of its enemies, the wisest in the choice of cover, and in measures for self-preservation."

"Keen Birds and Dull Men" is an interesting comparison of the brightest of the feathered tribes with three of the lowest tribes of mankind. The conclusion is reached that "the highest animals intellectually are higher than the lowest men." . . . . "If the whole truth could be known, I believe it would be found that the stock of ideas possessed and used by the groups of highly-endowed birds would fully equal the ideas of such tribes of simple-minded men as those mentioned." The chapters on the mental status of the orang-utan, chimpanzee, gorilla, and elephant are among the most valuable and interesting of the book. Space forbids a detailed account of their contents, and in fact they must be read in their entirety to be fully appreciated. The reader will emerge quite in sympathy with the conclusion that "the study of this ape's mind (Peter, a chimpanzee) is a subject fit, not for the animal psychologist, but for the child psychologist." "The Wisdom of the Serpent" is a chapter to be most highly commended. Certain aphorisms are worthy of quotation. "A fool and his snake are soon parted." "If your police record is clear, you can sleep safely in the sage-brush." "The largest snakes of the world exist only in the human mind." "Men do far more fighting per capita than any snakes yet discovered."

By no means the least valuable chapter is that on "The Training of Wild Animals." "It is incontestably true that dull and stupid animals can learn little, and perform less. . . . . Really, the brain, the memory and reason must enter into every animal performance that amounts to anything worth while."

The author's point of view in the last two sections on the higher and lower passions of wild animals is set forth in such words as these, "Wild animals *have*

moral codes, and . . . . on the average they live up to them better than men do to theirs." "The crimes of captive animals are many, but the crimes of free wild animals are comparatively few." In his discussion of the play of animals Hornaday expresses a commendable wish when he says, "Very sincerely do we wish that at least one of the many romance writers who are so industriously inventing wild-animal blood-and-thunder stories would do more work with his eyes and less with his imagination."

The concluding paragraphs of this interesting and stimulating volume are worth quoting as the mature conclusions of one who knows wild animals with an intimacy possessed by few other men living or dead. He says:

"On one side of the heights above the River of Life stand the men of this little world,—the fully developed, the underdone, and the unbaked, in one struggling seething mass. On the other side, and on a level but one step lower down, stands the vanguard of the long procession of 'Lower' Animals, led by the chimpanzee, the orang and the gorilla. The natural bridge that *almost* spans the chasm lacks only the keystone of the arch. Give the apes just one thing—speech,—and the bridge is closed!

"Take away from a child its sight, speech and hearing, and the whole world is a mystery, which only the hardest toil of science and education ever can reveal. Give back hearing and sight, without speech, and even then the world is only half available. Give a chimpanzee articulate expression and language, and no one could fix a limit to his progress. Take away from a man the use of one lobe of his brain, and he is rendered speechless.

"The great Apes have travelled up the River of Life on the opposite side from Man, but they are only one lap behind him. Let us not deceive ourselves about that. Remember that truth is inexorable in its demand to be heard.

"We need not rack our poor, finite minds over the final problem of evolution, or the final destiny of Man and Ape. We cannot prove anything beyond what we see. We do not know, and we never can know, whether the chimpanzee has a 'soul' or not; and we cannot *prove* that the soul of man is immortal. If man possesses a soul of lofty stature, why not a soul of lowly stature for the chimpanzee? We do not know just *where* 'heaven' is; and we cannot know until we find it. But what does it all matter on earth, if we keep to the straight path, and rest our faith upon the Great Unseen Power that we call God? Said the great Poet of Nature in his ode 'To a Waterfowl,'

> " 'He who from zone to zone
> Guides through the boundless sky thy certain flight,
> In the long way that I must tread alone
> Will lead my steps aright.' "

This is a work that will be received with approval neither by the "behaviorists" who insist that to know an animal's mind it must be subjected to laboratory tests utterly foreign to its usual life-experiences, nor by the orthodox psychologist who looks upon the human mind as differing in kind from that of lower forms. But to the lover of wild animals in their native haunts it has an appeal that defies over-statement. It is a continuous invitation to come out into the wilds and see for one's self. Doctor Hornaday is to be thanked for having given to naturalists such an interesting and trustworthy account of the results of his many years of association with the life of animals.

—*H. H. Lane.*

Webster, E. B. THE KING OF THE OLYMPICS. THE ROOSEVELT ELK AND OTHER MAMMALS OF THE OLYMPIC MOUNTAINS. Port Angeles, Washington; the Port Angeles Evening News. 8vo, 227 pp., numerous unnumbered half-tones. 1920.

Significant of the increasing interest in the out-of-doors in the Pacific Northwest is the appearance of this attractive volume by E. B. Webster, moving spirit and leader of the Klahhane mountaineering club of Port Angeles, Washington, and member also of the Pacific Northwest Bird and Mammal Club and the American Society of Mammalogists. It is written, not from the standpoint of sportsman or technical mammalogist, but from that of a mountaineer and friend of wild life.

The King of the Olympics is, of course, the Roosevelt elk, *Cervus roosevelti* Merriam or *Cervus canadensis occidentalis* Hamilton Smith, and the longest and most important chapter of the book is very properly devoted to a study of this magnificent animal in its principal habitat. The author has made a valuable contribution to knowledge of the habits and relations to environment of the elk, including its protective coloration, trails, present and former distribution in the Olympic Mountains, food, herding and breeding habits, fighting, young, and enemies. Many of the data were gathered by Mr. Webster himself in course of frequent trips to the mountains; and, in addition, the observations of William Everett, Chris Morganroth, George Welch, and Grant Humes, mountain men of wide experience in the Olympic region, have been freely drawn upon.

It was found that the lives of the wolf, cougar, bear, and deer were so closely linked with that of the elk that accounts of their habits seemed necessary to complete the story of the elk. "This done it was but a step to the remaining mammals of the Olympics—some thirty odd chapters in all." Among these accounts, those of the cougar, marmot, timber wolf, chehalis (mountain beaver), and black bear are of special value.

The book is illustrated with numerous half-tones, including several of the elk in its normal environment. The typography is clear, the paper of excellent quality, and the binding plain but durable. An index would have made the volume somewhat more useful. The few scientific names included could have been made more acceptable if they had been edited by a technical mammalogist.

The author's style is informal and attractive, and an occasional story enlivens the text. The reader has no difficulty, however, in separating the "stories" from the serious observations of fact, which is more than can be said for some writings on natural history.

We wish the author had given us his opinion of what to do to insure the conservation of the elk, a matter which has been much discussed by protectionists, few of whom have had his extended opportunities for first-hand contact with the problem.

The book should help to stimulate popular interest in mammals, which deserve far more attention from conscientious writers on nature than they have received hitherto. It will be a welcome addition to any library pertaining to the woods, fields, and mountains, and their animal denizens.

—*Walter P. Taylor.*

ADAMS, CHARLES C. Suggestions for research on North American big game and fur-bearing animals. Roosevelt Wild Life Bull., vol. 1, no. 1, pp. 35–41. December, 1921.

AHRENS, THEODOR G. Aims and status of plant and animal preserve work in Europe, with special reference to Germany, including a list of the most important publications on these preserves. Roosevelt Wild Life Bull., vol. 1, no. 1, pp. 83–94. December, 1921.

ALLEN, GLOVER M. Bats from Palawan, Philippine Islands. Occ. Pap. Mus. Zool., Univ. Michigan, no. 110, pp. 1–5. February 25, 1922. (Seven species; *Rhinolophus anderseni aequalis* is new.)

ANDREWS, C. W. Note on the skull of Dinotherium giganteum in the British Museum. Proc. Zool. Soc. London, 1921, pt. 3, pp. 525–534. September, 1921.

ANTHONY, H. E. Preliminary report on Ecuadorean mammals. No. 2. Amer. Mus. Novit., no. 32, pp. 1-6; map. March 4, 1922. (New species of *Phyllotis*, *Microsciurus*, and *Marmosa*.)

——— A new fossil rodent from Ecuador. Amer. Mus. Novit., no. 35, pp. 1–4; 2 figs. March 30, 1922. (Describes *Drytomomys æquatorialis*, gen. et spec. nov.)

BAILEY, VERNON. The flag squirrel. Native Life (Bismarck, N. D.), vol. 2, no. 1, pp. 7–8. March, 1922. (Brief popular notes on habits of *Citellus tridecemlineatus*.)

BARBER, W. E. Deer still plentiful in Wisconsin. Wisconsin Conservationist, vol. 3, no. 6, p. 16. January (March), 1922. (Reports 4005 bucks killed in Wisconsin during open season of 1921, with probably an additional 500 to 1000 which were not reported.)

——— Again, our fur-bearing animals. Wisconsin Conservationist, vol. 4, no. 1, p. 11. March (May 11), 1922. (All fur-bearing animals in Wisconsin, excepting perhaps the skunk, are reduced to danger line. Beavers were unmercifully slaughtered during the past season.)

BARNES, CLAUDE T. Mammals of Utah. Bull. Univ. Utah, vol. 12, no. 15; 176 pp., 32 maps. April, 1922. (A list of the mammals known from Utah, with maps showing their distribution in the state.)

BEAKBANE, A. B. The case against the beaver. Forest and Stream, vol. 92, no. 5, pp. 203, 236, 239–240. May, 1922. (Claims that beavers are fast destroying trout streams in the Adirondacks.)

BRINKMANN, AUGUST. Canidenstudien. Vidensk. Meddel. fra Dansk naturhist. Foren. Kjøbenhavn, vol. 72, pp. 1–43; pls. 1–3; text figs. 1-6. 1921. (*Canis pallipes* is distinct from *C. lupus* and is the original of the large domestic greyhounds.)

CADWALADER, WILLIAMS B. The fiftieth annual report of the board of directors of the Zoological Society of Philadelphia. Pp. 52. 1922.

CASTLE, W. E. Genetics of the Vienna white rabbit. Science, n.s., vol. 55, pp. 269–270. March 10, 1922.

CLARK, D. H. Against the buck law. Wisconsin Conservationist, vol. 3, no. 6, p. 11. January (March), 1922. (Opposes "one buck law.")

COLE, H. E. Wild life in Baraboo Hills. Wisconsin Conservationist, vol. 3, no. 6, p. 9. January (March), 1922. (Largely an account of a raccoon farm and raccoon habits.)

COLEMAN, LAURENCE VAIL. Some principles of group construction. Museum Work, vol. 3, pp. 121–125. January, 1921. (Particular reference to museum groups of mammals.)

COOPER, C. FORSTER. Metamynodon bugtiensis, sp. n., from the Dera Bugti deposits of Baluchistan.—Preliminary notice. Ann. and Mag. Nat. Hist., ser. 9, vol. 9, pp. 617-620; 2 figs. May, 1922.

DICE, LEE RAYMOND. Some factors affecting the distribution of the prairie vole, forest deer mouse, and prairie deer mouse. Ecology, vol. 3, pp. 29–47. January (March), 1922.

DICE, L. R., AND H. B. SHERMAN. Notes on the mammals of Gogebic and Ontonagon Counties, Michigan, 1920. Occ. Pap. Mus. Zool., Univ. Michigan, no. 109, pp. 1–46; 3 plates. February 25, 1922. (Lists 42 species.)

DOLLMAN, J. G. Catalogue of the Selous collection of big game in the British Museum (Natural History). London: British Museum; pp. i–vii; 1–112; portrait. 1921.

ÉHIK, J. The glacial-theories in the light of biological investigation. Ann. Mus. Hung., Budapest, vol. 18, pp. 89–110; 7 figs. 1921.

FRICK, CHILDS. Extinct vertebrate faunas of the badlands of Bautista Creek and San Timoteo Cañon, southern California. Univ. California Pub. Geol., vol. 12, no. 5, pp. 277–424; pls. 43–50; 165 figs. in text. December 28, 1921. (New species of *Equus*, *Pliohippus*, *Tapirus*, *Pliauchenia*, *Procamelus*, *Prosthennops*, *Hypolagus*, and *Hyaenarctos*.)

GARLAND, H. P. The water buffalo (often called the mud buffalo) its characteristics and habits together with a description of the preparation of its hide for making loom pickers. Pp. 1–51; 38 figs. Garland Manufacturing Co., Saco, Maine. Smith and Porter press, Boston. 1922. (A most attractive book on the water buffalo and its economic uses.)

HALL, FRANK GREGORY. The vital limit of exsiccation of certain animals. Biol. Bull., vol. 42, pp. 31–51. January, 1922. (Includes *Peromyscus leucopus noveboracensis*, *Microtus pennsylvanicus*, and *Mus musculus* among the animals used in experiments.)

HANNA, G. DALLAS. What becomes of the fur seals. Science, n.s., vol. 55, pp. 505–507. May 12, 1922. (Suggests an investigation of the activities of the killer whale.)

HARMER, S. F. Report on Cetacea stranded on the British coasts during 1919 and 1920. British Museum, no. 7, pp. 1–18; map. February 26, 1921.

HAY, OLIVER P. Occurrence of Scott's gray fox in probably recent cave deposits in Kentucky. Proc. Biol. Soc. Washington, vol. 35, pp. 53–54. March 20, 1922.

HINTON, M. A. C., AND R. C. WROUGHTON. The synonymies, characters and distribution of the macaques included under the names *rhesus* and *assamensis* in Blanford's Mammals. Journ. Bombay Nat. Hist. Soc., vol. 27, pp. 665-672. 1921. (The name of the common rhesus monkey becomes *Macaca mulatta*.)

——— On the nomenclature of the South Indian long-tailed macaques. Journ. Bombay Nat. Hist. Soc., vol. 27, pp. 813-815. 1921.

HORNADAY, WILLIAM T. Will our vanishing game be saved. Wisconsin Conservationist, vol. 3, no. 6, p. 7. January (March), 1922.

HOWE, INEZ ADDIE. Habitat groups at the Fairbanks Museum. Museum Work, vol. 3, pp. 125–127. January, 1921. (Describes in some detail muskrat group in Fairbanks Museum, St. Johnsburg, Vermont, and mentions groups of opossum, woodchuck, bison, and moose.)

JACKSON, HARTLEY H. T. New species and subspecies of *Sorex* from western America. Journ. Washington Acad. Sci., vol. 12, no. 11, pp. 262–264. June 4, 1922. (New forms described from British Columbia, Oregon, and California.)

JENNESS, D. The life of the Copper Eskimos. Rep. Canadian Arctic Exped. 1913–18, vol. 12, pp. 1–277, 9 plates, 69 figs., 2 maps. Ottawa, 1922. (Contains numerous valuable notes on Arctic mammals.)

JONES, F. WOOD. The external characters of pouch embryos of marsupials. No. 2.—*Notoryctes typhlops*. Trans. Roy. Soc. South Australia, vol. 14, 1921.

——— The status of the dingo. Trans. Roy. Soc. South Australia, vol. 14, pp. 254–263. 1921. (Believes that the dingo is simply a subspecies of *Canis familiaris* introduced into Australia by man.)

KELLOGG, REMINGTON. Change of name. Proc. Biol. Soc. Washington, vol. 35, p. 78. March 20, 1922. (*Microtus californicus neglectus* Kellogg becomes *M. c. sanctidiegi*.)

——— Pinnipeds from Miocene and Pleistocene deposits of California. A description of a new genus and species of sea lion from the Temblor together with seal remains from the Santa Margarita and San Pedro formations and a résumé of current theories regarding origin of Pinnipedia. Univ. Calif. Pub. Dept. Geol. Sci., vol. 13, pp. 23–132, 6 figs. April 14, 1922.

——— A study of the Californian forms of the Microtus montanus group of meadow mice. Univ. Calif. Pub. Zool., vol. 21, no. 7, pp. 245–274; 25 figs. April 18, 1922.

——— A synopsis of the Microtus mordax group of meadow mice in California. Univ. Calif. Pub. Zool., vol. 21, no. 8, pp. 275–302; 1 plate; 29 figs. April 18, 1922. (New subspecies: *Microtus mordax sierrae*, Yosemite National Park.)

KINGSLEY, A. W. Another opponent. Wisconsin Conservationist, vol. 3, no. 6, p. 11. January (March), 1922. (Opposes the "one buck law" for deer.)

KLATT, BERTHOLD. Mendelismus Domestikation und Kraniologie. Archiv für Anthropologie, Neue Folge, vol. 18, pp. 225–250; 4 figs. 1921. (Repeats the error of comparing the skull of the ferret, *Putorius* near *eversmanni*, with that of the polecat, *P. putorius*, and attributing the differences in form to changed habits under domestication.)

LAWSON, PUBLIUS V. Thure Kumlien. Trans. Wisconsin Acad. Sci., Arts and Letters, vol. 20, pp. 663–686; pls. 62–64. March, 1922. (Account of the life of the naturalist Thure Kumlien.)

LONGMAN, HEBER A. A Queensland rabbit-bandicoot. Queensland Nat., vol. 3, no. 3, pp. 52–53. February, 1922.

LÖNNBERG, EINAR. A third contribution to the mammalogy of Ecuador. Archiv för Zoologi, vol. 14, no. 20, pp. 1–23; 3 figs. 1922. (New: *Callicebus cupreus napoleon*, Napo River; *Odocoileus peruvianus consul*, Guamani; and *Choloepus napensis*, Napo River.)

LÖNNBERG, EINAR. Some remarks about eastern hedgehogs. Ann. and Mag. Nat. Hist., ser. 9, vol. 9, pp. 620–629. May, 1922. (Describes *Erinaceus koreanus*, sp. nov.)

LOVERIDGE, ARTHUR. Notes on East African Mammalia (other than horned ungulates) collected or kept in captivity 1915–1919. Part II. Journ. East Africa and Uganda Nat. Hist. Soc., no. 17, pp. 39–69. March, 1922.

MARCHAL, PAUL. Destruction des campagnols. Comptes Rendus Séances Acad. Agric. France, vol. 8, pp. 130–131. February, 1922. (Successful use of a modified Danyze virus in destroying field mice in departments of Marne, Meuse, and Ardennes, France.)

MARTINO, V. AND E. Note on a new snow-vole from Montenegro [*Microtus (Chionomys) bogdanovi*, sp. n.]. Ann. and Mag. Nat. Hist., ser. 9, vol. 9, p. 413. April, 1922.

MATSUMOTO, H. *Megalohyrax* Andrews and *Titanohyrax*, g.n.—A revision of the genera of hyracoids from the Fayûm, Egypt. Proc. Zool. Soc. London, 1921, pt. 4, pp. 839–850. January, 1922.

MATTHEW, W. D. Urus and bison. Nat. Hist., vol. 21, pp. 598–606; 4 figs. November–December, 1921.

——— Why palæontology? Nat. Hist., vol. 21, pp. 639–641. November–December, 1921.

MCNAUGHTON, JAMES W. A stray moose. Wisconsin Conservationist, vol. 3, no. 6, p. 12. January (March), 1922. (Moose lassoed September 11, 1921, in Allouez Bay, Lake Superior, while swimming toward Wisconsin shore.)

NELSON, E. W. Decrease of fur-bearing animals in Alaska. Nat. Hist., vol. 22, p. 83. January–February, 1922.

ORTLEPP, M. A. A new trichostrongyle genus from an armadillo, *Euphractus villosus*. Ann. and Mag. Nat. Hist., ser. 9, vol. 9, pp. 413–421. April, 1922.

OSBORN, HENRY FAIRFIELD. The dawn man of Piltdown, Sussex. Nat. Hist., vol. 21, pp. 577–590; 15 figs. November–December, 1921. (The Piltdown jaw is human, not chimpanzee, and belongs with the skull of *Eoanthropus*.)

——— Hesperopithecus, the first anthropoid primate found in America. Science, n.s., vol. 55, pp. 463–465. May 5, 1922. (Describes *Hesperopithecus haroldcookii* from Agate, Nebraska; Pliocene.)

PALMER, T. S. Game as a national resource. U. S. Dept. Agric., Bull. 1049, pp. 1–48. March 14, 1922. (Contains much information on big game.)

POCOCK, R. I. The auditory bulla and other cranial characters in the Mustelidæ. Proc. Zool. Soc. London, 1921, pt. 3, pp. 473–486. September, 1921.

——— On the external characters of some species of Lutrinæ (otters). Proc. Zool. Soc. London, 1921, pt. 3, pp. 535–546. September, 1921.

SCHEFFER, THEO. H. American moles as agricultural pests and as fur producers. U. S. Dept. Agric., Farm. Bull. 1247. 23 pp., 16 figs. March, 1922.

SCHWARZ, ERNST. Huftiere aus West- und Zentralafrika. Ergebnisse der Zweiten Deutschen Zentral-Afrika-Exped. 1910–11, vol. 1, Zoologie, pp. 831–1044; pls. 33–48. June, 1920.

——— Fledermäuse aus West- und Zentralafrika. Ergebnisse der Zweiten Deutschen Zentral-Afrika-Exped. 1910–11, vol. 1, Zoologie, pp. 1045–1062. June, 1920.

SCHWARZ, ERNST. Nagetiere aus West- und Zentral-Afrika. Ergebnisse der Zweiten Deutschen Zentral-Afrika-Exped. 1910–11, vol. 1, Zoologie, pp. 1063–1090. June, 1920.

SHUFELDT, R. W. The exhibition series of birds and mammals in the United States National Museum. Museum Work, vol. 3, pp. 178–185. March, 1921.

SONNTAG, CHARLES F. The comparative anatomy of the tongues of the Mammalia. IV. Families 3 and 4. Cebidæ and Hapalidæ. Proc. Zool. Soc. London, 1921, pt. 3, pp. 497–524. September, 1921.

——— The comparative anatomy of the koala (*Phascolarctos cinereus*) and the vulpine phalanger (*Trichosurus vulpecula*). Proc. Zool. Soc. London, 1921, pt. 3, pp. 547–577; pls. 5–6. September, 1921.

——— On some abnormalities in the Carnivora. Proc. Zool. Soc. London, 1921, pt. 3, pp. 587–590. September, 1921.

——— The comparative anatomy of the tongues of the Mammalia. V. Lemuroidea and Tarsioidea. Proc. Zool. Soc. London, 1921, pt. 4, pp. 741–755. January, 1922.

——— The comparative anatomy of the tongues of the Mammalia. VI. Summary and classification of the tongues of the Primates. Proc. Zool. Soc. London, 1921, pt. 4, pp. 757–767. January, 1922.

——— Contributions to the visceral anatomy and myology of the Marsupialia. Proc. Zool. Soc. London, 1921, pt. 4, pp. 851–882. January, 1922.

SOPER, J. DEWEY. Gleanings from the Canadian West. Part II. Mammalian fauna of Islay, Alberta. Canadian Field-Nat., vol. 35, pp. 102–111. (September, 1921) February 3, 1922.

STUCK, HUDSON. Some game trails of Alaska. Country Life, vol. 40, no. 3, pp. 35–39; 3 col. pls. and 6 figs. July, 1921.

THOMAS, OLDFIELD. On a collection of rats and shrews from the Dutch East Indian Islands. Treubia, vol. 2, livr. 1, pp. 109–114. 1921.

——— Scientific results from the Mammal Survey. XXVII. The geographical races of *Scotomanes ornatus*. Journ. Bombay Nat. Hist. Soc., vol. 27, pp. 772–773. 1921.

——— A subdivision of the genus *Uromys*. Ann. and Mag. Nat. Hist., ser. 9, vol. 9, pp. 260–261. March, 1922. (New genus, *Melomys*, for *Uromys rufescens* and allied forms.)

——— New mammals from New Guinea and neighboring islands. Ann. and Mag. Nat. Hist., ser. 9, vol. 9, pp. 261–265. March, 1922.

——— A new marmoset from the Lower Amazons. Ann. and Mag. Nat. Hist., ser. 9, vol. 9, pp. 265–266. March, 1922. (Describes *Mystax ursulus umbratus*.)

——— The generic classification of the *Taphozous* group. Ann. and Mag. Nat. Hist., ser. 9, vol. 9, pp. 266–267. March, 1922. (New genus: *Liponycteris*.)

——— The forms of *Jaculus jaculus* in Egypt and Syria. Ann. and Mag. Nat. Hist., ser. 9, vol. 9, pp. 295–297. April, 1922.

——— Two new jerboa-rats (*Notomys*). Ann. and Mag. Nat. Hist., ser. 9, vol. 9, pp. 315–317. April, 1922.

——— On the animals known as "ground-hogs" or "cane-rats" in Africa. Ann. and Mag. Nat. Hist., ser. 9, vol. 9. pp. 389–392. April, 1922. (De-

scribes new subspecies of *Thryonomys swinderianus;* and a new genus, *Chæromys*, for *T. gregorianus* and its allies.)

TOWERRE, R. W. A whaling trip. Wisconsin Conservationist, vol. 4, no. 1, pp. 8, 10. March (May 11), 1922.

TROXELL, EDWARD L. Oligocene rodents of the genus Ischyromys. Amer. Journ. Sci., ser. 5, vol. 3, pp. 123–130; 7 figs. February, 1922. (New species from Middle Oligocene, Cherry Creek, Colorado, and from Lower Oreodon beds near Harrison, Nebraska.)

TUBANGUI, MARCOS A. Two new intestinal trematodes from the dog in China. Proc. U. S. Nat. Mus., vol. 60, art. 20, pp. 1–12, 4 pls. May, 1922.

WALLACE, A. F. Timber wolf. Wisconsin Conservationist, vol. 3, no. 6, p. 11. January (March), 1922. (Methods of trapping.)

WHITMAN, ROGER B. Hunting with brush and gun. Country Life, vol. 40, no. 5, pp. 34–39; 5 half-tones and 4 colored plates. September, 1921. (Paintings and sketches of big game by Carl Rungius.)

WROUGHTON, R. C. On the *erythræus* group of squirrels. Journ. Bombay Nat. Hist. Soc., vol. 27, pp. 773–777. 1921.

FOURTH ANNUAL MEETING OF THE AMERICAN SOCIETY OF MAMMALOGISTS

The fourth annual meeting of the American Society of Mammalogists was held in the American Museum of Natural History, New York City, May 16–18, 1922. There were 52 members in attendance. One of the more important items of business transacted was the hearty endorsement of the raising of a publication fund in honor of the late Dr. J. A. Allen. This fund is to be known as the Allen Memorial Fund and is to be administered by the directors of the Society. It is planned to raise not less than $10,000, the income of which shall be used for the publication of certain numbers of the Journal of Mammalogy to be dedicated to the memory of Doctor Allen. Thus in creating this fund we shall not only honor this eminent and pioneer mammalogist, our first honorary member, and a man beloved by all who knew him, but we shall also make possible the publication of a number of the Journal about once every year from the proceeds of the fund. This should enable us to increase the pagination of each number of the Journal to at least 100 pages. Each member of the Society will be given an opportunity to contribute to the memorium. Let us make an actual sacrifice for this cause, realizing that by so doing we shall not only continually bring to life the memory of Doctor Allen, but shall enhance our more selfish interests by improving the Journal of Mammalogy. The Allen Memorial committee appointed by the president consists of Mr. Madison Grant, chairman; Dr. Henry Fairfield Osborn; Mr. Childs Frick; Dr. George Bird Grinnell, and Mr. H. E. Anthony. Local committees to act with the central committee may be appointed later.

The Directors of the Society sanctioned the organization of the Southern California Section of the American Society of Mammalogists, of which Mr. A. B. Howell has been elected president, and Mr. Luther Little secretary.

The competitive exhibition of photographs of mammals, installed by the American Museum of Natural History in connection with the meeting, was a

noteworthy success. Nearly 1700 photographs from about 140 persons were exhibited. The judges appointed by the Society were Dr. Wilfred H. Osgood, chairman; Mr. H. E. Anthony; Dr. Witmer Stone; Mr. Charles R. Knight, and Mr. James L. Clark. The awards were as follows:

I. PHOTOGRAPHS OF MAMMALS IN THE WILD STATE

1st Prize	John M. Phillips	Mountain Goat
2nd Prize	Norman McClintock	White-tailed Deer
3rd Prize	Edmund Heller	Mountain Sheep
1st Honorable mention	Carl E. Akeley	Hartebeest
2nd Honorable mention	Donald R. Dickey	Deer
3rd Honorable mention	Kermit Roosevelt	African Elephant
4th Honorable mention	Edward Mallinckrodt	Brown Bear
5th Honorable mention	Donald B. MacMillan	Polar Bear

II. PHOTOGRAPHS OF MAMMALS IN CAPTIVITY

1st Prize	Elwin R. Sanborn	Chimpanzee
2nd Prize	J. E. Haynes	Bison Stampede
3rd Prize	W. Lyman Underwood	Bay Lynx
1st Honorable mention	Mr. and Mrs. Ernest H. Baynes	Wolf
2nd Honorable mention	J. B. Pardoe	Flying Squirrel
3rd Honorable mention	Joseph Dixon	Cougar Kittens
4th Honorable mention	Leland Griggs	Fox Head
5th Honorable mention	Arthur H. Fisher	Lioness

On November 20, 1921, the American Society of Mammalogists was constituted an affiliated society of the American Association for the Advancement of Science. At present 83 members of the mammal society are fellows of the American Association, which allows us one representative on the council of the Association. The Society will undoubtedly soon have among its members 100 fellows of the Association, when we shall be entitled to two representatives on the council of the Association. The by-laws of the American Association provide that members of affiliated societies have the privilege of becoming members of the American Association without payment of the usual entrance fee, if they make application before the second October 1 following their entrance into the Society. When a society first becomes affiliated this special privilege is offered to all of its members, the offer being open until the second October 1 following the ratification of the arrangements of affiliation. The Board of Directors elected the corresponding secretary to represent the Society in the council of the American Association.

The report of the corresponding secretary summarized the membership of the Society on May 16, 1922, thus:

Names of new members acted upon at this meeting	70
Subscribers added to Journal since May 3, 1921	18
Additional members and subscribers since May 3, 1921	88
Members May 3, 1921	527
Honorary members May 3, 1921	2
Subscribers May 3, 1921	62

Members delinquent 1920 dues May 3, 1921 (not receiving vol. 2 of Journal)	41
Distribution of Journal May 3, 1921	550
Deaths of honorary member and members since May 3, 1921	4
Resignations since May 3, 1921	15
Dropped for delinquency May 16, 1922	24
Subscriptions cancelled since May 3, 1921	3
Members May 16, 1922	555
Honorary member May 16, 1922	1
Members delinquent 1921 dues, May 16, 1922 (not receiving vol. 3 of Journal)	30
Lost addresses of members[1]	2
Members and honorary member receiving Journal, May 16, 1922	524
Subscribers May 16, 1922	77
Distribution of Journal, May 16, 1922	601
Net increase in distribution of Journal since May 3, 1921	51

The program follows:

TUESDAY, MAY 16

Morning Session, 10:00 a.m.

Meeting of the Board of Directors

10:45 a.m.

Business Session

1:00 p.m.

The Museum entertained the members of the Society at luncheon in the Members' Room.

Afternoon Session, 2:00 p.m.

1. The present status of the elk. E. A. Goldman. Fifteen minutes. Lantern slides.
2. Mammals of the mountain tops. William L. Finley. By title.
3. The water supply of desert mammals. Vernon Bailey. Thirty minutes. Lantern slides.
4. The evolutionary force of a wide range. Ernest Thompson Seton. Ten minutes.
5. A quantitative determination of damage to forage by the prairie-dog, *Cynomys gunnisoni zuniensis* Hollister. Walter P. Taylor. Fifteen minutes. Lantern slides.
6. Studies of the Yellowstone wild life by the Roosevelt Station. Charles C. Adams. Five minutes.
7. The part played by mammals in the World War. Ernest Harold Baynes. Forty minutes. Lantern slides.

Evening Session, 8:00 p.m.

The members of the Society met at the new home of the Explorers Club, 47 West 76th Street, for an informal conversazione.

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[1] Moses R. Cooper and E. M. Prutsman.

WEDNESDAY, MAY 17

Morning Session, 10:00 a.m.

8. The frequency and significance of bregmatic fontanelle bones in mammals. Adolph H. Schultz. Thirty minutes. Lantern slides.
9. A fossil dugong from Florida. Glover M. Allen. Ten minutes. Lantern slides.
10. Food-storing by the meadow-mouse. Glover M. Allen. Five minutes.
11. Certain glands in the dog tribe. Ernest Thompson Seton. By title.
12. The elephant in captivity. W. H. Sheak. Twenty minutes.
13. The burrowing rodents of California as agents in soil formation. J. Grinnell. (Presented by E. A. Goldman.) Twenty minutes.

Afternoon Session, 2:00 p.m.

Symposium on the Anatomy and Relationships of the Gorilla.

14. How near is the relationship of the gorilla-chimpanzee stock to man? W. K. Gregory. Thirty minutes. Lantern slides.
15. Notes on the comparative anatomy of the gorilla. G. S. Huntington. Thirty minutes.
16. Was the human foot derived from a gorilloid type? D. J. Morton. Thirty minutes. Lantern slides.
17. Reichenow's observations on gorilla behavior. J. H. McGregor. Twenty minutes. Lantern slides.
18. On the sequence of eruption of permanent teeth in gorilla and man. Milo Hellman. Fifteen minutes. Lantern slides.
19. Phylogenetic relations of the gorilla: evidence from brain structure. Frederick Tilney. Twenty minutes. Lantern slides.
20. The phylogeny of the human foot; the testimony presented by the friction-ridge configuration. H. H. Wilder. (Presented by W. K. Gregory.) Ten minutes.

6:45 p.m.

The members assembled at the Hotel San Remo for dinner.

Evening Session, 8:00 p.m.

21. The motion picture as a medium for intimate animal studies. Two reels. Arthur H. Fisher.
22. Motion pictures, some showing slow motion, of Anthropoidea, sea lion, Barbary sheep, kangaroo and yak, and the habits of the beaver. Three reels. Raymond L. Ditmars.
23. Adventures of a gray squirrel. One reel. G. Clyde Fisher.

THURSDAY, MAY 18

Morning Session, 10:00 a.m.

24. Close of the age of mammals. Henry Fairfield Osborn and H. E. Anthony. Twenty minutes. Lantern slides.

(This paper developed almost into a symposium on the subject with extensive remarks by W. T. Hornaday, W. D. Matthew, W. H. Osgood, C. C. Adams, and E. W. Nelson.)

11: 30 a.m.

25. The American Museum of Natural History dedicated the North American Mammal Hall to the memory of the Society's only American Honorary Member, the late Dr. J. A. Allen. Professor Henry Fairfield Osborn, president of the Museum, presided. Among the speakers Dr. F. M. Chapman made a few remarks on the behalf of the American Museum and Dr. E. W. Nelson, president of the Society, presented an appreciation of Doctor Allen's service to natural history.

11: 45 a.m.

Final Business Session

12: 00 Noon

Members met at the American Museum of Natural History and were escorted by Dr. W. T. Hornaday to the Bronx Park, where they were the guests of the New York Zoological Society at luncheon at 1: 30 p.m. at the Rocking Stone Restaurant. This was followed by a private view of the new halls of the National Collection of Heads and Horns and a tour through the park under the guidance of the officers of the Zoological Society.

—*Hartley H. T. Jackson.*

LIST OF MEMBERS OF THE AMERICAN SOCIETY OF MAMMALOGISTS

(Corrected to July 1, 1922)

Names of life members are marked with an asterisk.

Honorary member

TROUESSART, PROF. E., Museum d'Histoire Naturelle, 57, Rue Cuvier, Paris, France.....1921

Members

ABBOTT, CLINTON G., Natural History Museum, San Diego, Calif.....1922
ABBOTT, DR. WILLIAM LOUIS, 400 S. 15th St., Philadelphia, Pa.....Charter
ADAMS, DR. CHAS. C., The N. Y. State College of Forestry, Syracuse, N. Y.....Charter
AHRENS, DR. THEODOR G., Landauerstrasse 4, Berlin Wilmersdorf, Germany.1921
AINSWORTH, MAJ. GEN. F. C., The Concord, Washington, D. C.....1921
AKELEY, CARL E., American Museum of Natural History, New York City.....Charter
ALBRIGHT, HORACE M., Supt. Yellowstone National Park, Yellowstone Park, Wyo.....Charter
*ALEXANDER, MISS ANNIE M., Suisun, Calif.....Charter
ALEXANDER, E. GORDON, E. Arrow St., Marshall, Mo.....Charter
ALLEN, DR. ARTHUR A., McGraw Hall, Ithaca, N. Y.....Charter
ALLEN, DR. GLOVER M., 234 Berkeley St., Boston, Mass.....Charter
*ALLIS, DR. EDWARD PHELPS, JR., Palais de Carnoles, Menton, A. M., France.....1922
ANDERSON, DR. RUDOLPH M., Victoria Memorial Museum, Dept. of Mines, Ottawa, Canada.....Charter

ANDREWS, ROY C., American Museum of Natural History, New York City.....Charter
ANTHONY, A. W., Museum of Natural History, Balboa Park, San Diego, Calif.....Charter
ANTHONY, H. E., American Museum of Natural History, New York City, Charter
ASCHEMEIER, C. R., U. S. National Museum, Washington, D. C.....Charter
ASHBROOK, FRANK G., U. S. Biological Survey, Washington, D. C.....1922
BABCOCK, DR. HAROLD L., Woodleigh Road, Dedham, Mass.....Charter
BADÉ, DR. WILLIAM FREDERIC, 2616 College Ave., Berkeley, Calif.....Charter
BAGG, DR. CLINTON L., 56 W. 52nd St., New York City.....Charter
BAILEY, A. M., Colorado Museum of Natural History, Denver, Colo...Charter
BAILEY, BERNARD, R. F. D. No. 1, Elk River, Minn.....Charter
BAILEY, DR. EDNA W., 1016 Spruce St., Berkeley, Calif.....1922
BAILEY, FLORENCE MERRIAM, 1834 Kalorama Road, N. W., Washington, D. C.....Charter
BAILEY, H. B., P. O. Box 112, Newport News, Va.....Charter
BAILEY, HAROLD H., Box S, Miami Beach, Fla.....Charter
BAILEY, VERNON, 1834 Kalorama Road, N. W., Washington, D. C.....Charter
BAIRD, KATHERINE B., 815 Webster St., N. W., Washington, D. C.....Charter
BAKER, A. B., National Zoological Park, Washington, D. C.....Charter
*BALDWIN, S. PRENTISS, Willamson Building, Cleveland, Ohio.....1922
BALES, DR. B. R., Circleville, Ohio.....1921
BALL, EDWARD M., East Falls Church, Va.....Charter
BANGS, OUTRAM, Museum of Comparative Zoology, Cambridge, Mass..Charter
BANNON, ARTHUR H., 1404 Offnere St., Portsmouth, Ohio.....1922
BANNON, HENRY, First National Bank Bldg., Portsmouth, Ohio.....1922
BARBOUR, DR. THOMAS, Museum of Comparative Zoology, Cambridge, Mass.....Charter
BARNES, CLAUDE T., 359 10th Ave., Salt Lake City, Utah.....Charter
BARRETT, CHARLES H. M., 1339 Valley Place, S. E., Washington, D. C..Charter
BARROWS, PROF. WALTER B., P. O. Box 1047, East Lansing, Mich.....Charter
BARTLETT, KING, Locke's Mills, Me.....1920
BARTSCH, DR. PAUL, U. S. National Museum, Washington, D. C.....1921
BASCOM, KELLOGG F., Dept. of Zoology, University of Chicago, Chicago, Ill.....Charter
BASSETT, FRANK N., 1338 8th St., Alameda, Calif.....1921
BATCHELDER, CHAS. F., 7 Kirkland St., Cambridge, Mass.....Charter
BATEMAN, ROBERT E., Box 1251, Billings, Mont.....Charter
BAYNES, ERNEST HAROLD, Meriden, N. H.....1921
BEACH, WILLIAM N., 30 E. 42nd St., New York City.....Charter
BEARD, THEODORE R., Box 791, Sapulpa, Okla.....1921
BECK, ROLLO H., R. R. A. 288, San Jose, Calif.....Charter
BEEBE, WILLIAM, New York Zoological Park, New York City.....Charter
BELL, JAMES F., 2215 Park Avenue, Minneapolis, Minn.....1921
BELL, DR. W. B., 803 Rittenhouse St., N. W., Washington, D. C.....Charter
BENSLEY, PROF. B. A., University of Toronto, Toronto, Ontario.....1921
BERGTOLD, DR. W. H., 1159 Race St., Denver, Colo.....Charter

BIBB, DR. J. PORTER, 111 Moulton St., Montgomery, Ala.....1921
BIGGS, O. S., San Jose, Ill.....1920
BIRDSEYE, CLARENCE, Yorktown Heights, N. Y.....Charter
BISHOP, SHERMAN C., Division of Zoology, N. Y. State Museum, Albany, N. Y.....Charter
BLAAUW, DR. F. E., Gooilust, Graveland, Hilversum, Holland.....1921
BLACK, PROF. DAVIDSON, Dept. of Anatomy, Peking Union Medical College, Peking, China.....Charter
BLAKE, PROF. IRVING H., Dept. of Biology, University of Maine, Orono, Me.....Charter
BLICKENDERFER, CLARK, 850 Grant St., Denver, Colo.....1922
BLUNDELL, E. T., Island Lake, via Selkirk & Norway House, Manitoba...1921
BOES, RAYMOND E., 337 South Main St., Salt Lake City, Utah.....Charter
BOLT, BENJAMIN F., 1421 Prospect Ave., Kansas City, Mo.....Charter
BOWDISH, BEECHER S., Demarest, N. J.....1921
BRADFORD, LIEUT. GERARD, U. S. Navy Mine Depot, Yorktown, Va.....1922
BRADSHAW, F., Dept. of Agriculture, Regina, Alta.....Charter
*BRANDRETH, COURTENAY, Ossining, N. Y.....1921
BRANDRETH, FRANKLIN, Ossining, N. Y.....1921
BRANNON, PETER A., Box 358, Montgomery, Ala.....Charter
BRIGHT, STANLEY, Cedar Hill Farm, Reading, Pa.....1922
BRIMLEY, C. S., 515 Washington St., Raleigh, N. C.....Charter
BRIMLEY, H. H., State Museum, Raleigh, N. C.....Charter
BRINKMANN, DR. AUGUST, Bergens Museum, Bergens, Norway.....1921
BRODE, PROF. H. S., 433 East Alder St., Walla Walla, Wash.....Charter
BROOKS, A. B., 126 Pocahontas St., Buckhannon, W. Va.....1920
BROOKS, ALLAN, Okanagan Landing, B. C.....Charter
BROOKS, EARLE A., 10 Beacon St., Everett, Mass.....1921
BROOKS, FRED E., French Creek, W. Va.....Charter
BROWN, C. EMERSON, Philadelphia Zoological Garden, Philadelphia, Pa., Charter
BROWN, D. E., 87 Lenora Street, Seattle, Wash.....Charter
BROWN, E. J., 222 W. 4th Place, Los Angeles, Calif.....Charter
BROWN, LEE P., Forest Service, Ft. Collins, Colo.....1921
BROWN, WILLIAM L., National Museum, Washington, D. C.....Charter
BROWN, WILMOT W., Madera, Chihuahua, Mexico.....Charter
BRUUN, CHARLES A., Reliance Bldg., Kansas City, Mo.....Charter
BRYANT, DR. HAROLD C., Museum of Vertebrate Zoology, Berkeley, Calif., Charter
BRYANT, WILLIAM L., New Museum, 1231 Elmwood Ave., Buffalo, N. Y...1922
BULLOCK, D. S., c/o American Embassy, Buenos Aires, Argentina.....1921
BUMSTEAD, COL. DALE, 504 East Ave., N., Oak Park, Ill.....Charter
BURGESS, THORNTON W., 61 Washington Road, Springfield, Mass.....Charter
BURNETT, WM. L., State Agricultural College, Fort Collins, Colo.....Charter
BURNS, FRANK L., Berwyn, Pa.....Charter
BURRELL, HARRY, La Mascotte, Doncaster Ave., Kensington, New South Wales, Australia.....Charter

BURRELL, MRS. HARRY (SUSAN EMILY), La Mascotte, Doncaster Ave., New South Wales, Australia.....Charter
BUTLER, AMOS W., 52 Downey Ave., Irvington, Indianapolis, Ind.....Charter
BUTLER, RALPH E., Lost Harbor, via Seward, Alaska.....1922
BUWALDA, DR. JOHN P., Beacon Hall, University of California, Berkeley, Calif.....Charter
CABOT, WILLIAM B., 447 Marlboro St., Boston, Mass.....1922
CABRERA, ANGEL, Calle Claudio, Coello, 115, Madrid, Spain.....Charter
CAHN, PROF. ALVIN R., A. & M. College of Texas, College Sta., Texas...1921
CALDWELL, G. T., University Sta., Tucson, Ariz.....1922
CAMP, CHARLES L., Dept. of Geology, University of California, Berkeley, Calif.....Charter
CAMPBELL, Dr. J. A., 8 Edward St., Toronto, Ont.....1920
CANTWELL, GEORGE G., 901 W. Main Ave., Puyallup, Wash.....Charter
CARROLL, DR. MITCHEL, Franklin & Marshall College, Lancaster, Pa.....1922
CARTER, T. DONALD, American Museum of Natural History, New York City.....1922
CASAMAJOR, PROF. L., College of Physicians and Surgeons, New York City.1922
CASE, DR. E. C., University of Michigan, Ann Arbor, Mich.....Charter
CHAMBERS, W. LEE, Eagle Rock, Los Angeles Co., Calif.....Charter
CHANDLER, W. L., Michigan Agricultural College, East Lansing, Mich..Charter
CHAPIN, JAMES P., American Museum of Natural History, New York City.....Charter
CHARTERS, EMMA M., U. S. Biological Survey, Washington, D. C.....1921
CHEESMAN, WILLIAM H., Biological Survey, Washington, D. C.....Charter
CHURCH, MORTON L., Box 1236, Charlotte, North Carolina.....Charter
CHURCHILL, PROF. E. P., University of South Dakota, Vermillion, S. D....1921
CLARK, DR. BRUCE L., 212 Bacon Hall, University of California, Berkeley, Calif.....Charter
CLARK, ELTON, 18 Post Office Square, Boston, Mass.....Charter
CLARK, W. O., Framingham Centre, Mass.....Charter
CLAY, C. IRVIN, P. O. B. 353, Eureka, Calif.....Charter
COBB, DR. STANLEY, Ponkapoag, Mass.....1922
COCKERELL, PROF. T. D. A., 908 Tenth St., Boulder, Colo.....Charter
COLBURN, ALBERT E., 806 South Broadway, Los Angeles, Calif.....Charter
COLE, DR. LEON J., College of Agriculture, University of Wisconsin, Madison, Wis.....1922
COLLINS, A. M., A. M. Collins Manufacturing Co., Philadelphia, Pa.....1921
COLLINS, DR. HOMER H., Dept. of Zoology, University of Pittsburgh, Pittsburgh, Pa.....1921
CONGER, PROF. ALLEN C., Michigan Agricultural College, East Lansing, Mich.....Charter
CONOVER, H. BOARDMAN, 6 Scott St., Chicago, Ill.....Charter
COOKE, MISS MAY T., 1328 Twelfth St., N. W., Washington, D. C.....Charter
COOLIDGE, DANE, Dwight Way End, Berkeley, Calif.....Charter
COOPER, J. P., Rome, Ga.....Charter
COPELAND, DR. MANTON, Bowdoin College, Brunswick, Me.....Charter
COUCH, LEO K., State Capital, Olympia, Wash.....Charter

COURTNEY, WILBUR, Pullman, Wash.....1920
CRAM, WILLIAM EVERETT, Hampton Falls, N. H.....Charter
CRANDALL, LEE S., N. Y. Zoological Park, New York City.....1922
CRAVEN, J. W., 811 18th St., N. W., Washington, D. C.....Charter
CREASER, CHARLES W., 904 State St., Alma, Mich.....1920
CRIDDLE, NORMAN, Treesbank, Manitoba.....Charter
CRIDDLE, STUART, Treesbank, Manitoba.....Charter
CROSS, W. REDMOND, 31 Pine St., New York City.....1922
CUTTING, HEYWARD, 542 Fifth Ave., New York City.....1922
DAMMERMAN, KAREL WILLEM, Zoological Museum & Laboratory, Buitenzorg, Java.....Charter
DAVENPORT, DR. CHAS. B., Cold Spring Harbor, Long Island, N. Y.....1921
DAVIS, R. N., Everhart Museum, Scranton, Pa.....1922
*DAVIS, WILLIAM T., 146 Stuyvesant Place, Staten Island, N. Y.....1922
DAVISON, CHAS. STEWART, 7 Dey St., New York City.....Charter
DAY, DR. LEWIS J., 3015 Wilson Ave., Chicago, Ill.....Charter
DEARBORN, DR. NED, Sacket Harbor, N. Y.....Charter
DENNISON, HENRY S., Framingham, Mass.....1922
DEPUY, PERCY L., 1725 Leavenworth St., Manhattan, Kan.....1921
DEXTER, DR. JOHN S., Elroy, Wis.....Charter
DICE, DR. LEE R., Museum of Zoology, University of Michigan, Ann Arbor, Mich.....Charter
DICKERSON, MARY C., American Museum of Natural History, New York City.....Charter
DICKEY, DONALD R., 514 Lester Ave., Pasadena, Calif.....Charter
DICKINSON, CHARLES W., 39 Mill St., Smethport, Pa.....Charter
DILLE, FREDERICK M., Valentine, Neb.....Charter
DITMARS, RAYMOND L., New York Zoological Park, The Bronx, New York City.....1921
DIXON, JOSEPH S., Museum of Vertebrate Zoology, Berkeley, Calif....Charter
DONALDSON, DR. HENRY H., The Wistar Institute, Philadelphia, Pa...Charter
DUNN, DR. LESLIE C., Connecticut Agricultural Station, Storrs, Conn....1921
DWIGHT, DR. JONATHAN, 43 W. 70th St., New York City.....Charter
EATON, PROF. E. H., Hobart College, Geneva, N. Y.....1921
EDSON, JOHN M., Marietta Road, Bellingham, Wash.....Charter
EIFRIG, C. W. G., 504 Monroe Ave., Oak Park, Ill.....Charter
EKBLAW, W. ELMER, 711 W. Nevada St., Urbana, Ill.....1921
ELLIOTT, MRS. JANE S., U. S. Biological Survey, Washington, D. C....Charter
ELROD, PROF. MORTON J., Montana State University, Missoula, Mont..Charter
ENGLISH, PENNOYER F., A. & M. College of Texas, College Station, Texas..1922
EVANS, VICTOR J., Ninth St. & Grant Place, N. W., Washington, D. C..Charter
EVERMANN, DR. BARTON W., California Academy of Sciences, Golden Gate Park, San Francisco, Calif.....Charter
FARLEY, JACK, 46 S. Broadway, White Plains, N. Y.....1922
FERGUSON, HARRY L., Care of J. & S. Ferguson, 11 Thomas St., New York City 1922
FIGGINS, J. D., Colorado Museum of Natural History, City Park, Denver, Colo.....Charter

FINLEY, WILLIAM L., Jennings Lodge, Ore.....Charter
FISHER, DR. A. K., The Plymouth, 1236 11th St., N. W., Washington, D. C.....Charter
FISHER, ARTHUR H., Apt. 408, Florence Courts, Washington, D. C.....1921
FISHER, DR. G. CLYDE, American Museum of Natural History, New York City.....Charter
FLEISCHNER, I. N., 207 Ash St., Portland, Ore.....1920
FLEMING, J. H., 267 Rusholme Road, Toronto, Ont.....Charter
FLOWER, MAJOR S. S., Zoological Gardens, Giza, Egypt.....1921
FOSTER, FRANCIS A., Edgartown, Mass.....1922
FRASER, DR. CHARLES M., University of British Columbia, Vancouver, B. C.....1921
FREEMAN, DANIEL, 711 7th St., S., Fargo, N. D.....Charter
FREY, MERLE F., Box 103, Buena Vista, Colo.....1921
FRIBLEY, EARL F., Sumner, Ill.....Charter
FRICK, CHILDS, Roslyn, Long Island, N. Y.....Charter
FROST, N. W., Cody, Wyo.....1922
FUERTES, LOUIS AGASSIZ, Cornell Heights, Ithaca, N. Y.....Charter
FULLER, ARTHUR B., Boston Society of Natural History, 234 Berkeley St., Boston, Mass.....Charter
GABRIELSON, IRA N., 515 Post Office Bldg., Portland, Ore.....Charter
GARLOUGH, F. E., 2024 Channing Way, Berkeley, Calif.....Charter
GARRETSON, M. S., Clifton, N. J.....1921
GAUDETTE, MARIE E., Park Museum, Providence, R. I.....1922
GAULT, BENJAMIN T., 564 N. Main St., Glenellyn, Du Page Co., Ill...Charter
GAUMER, DR. GEORGE F., Izamal, Yucatan.....1921
GIANINI, CHARLES A., Poland, N. Y.....Charter
GIDLEY, DR. JAMES W., U. S. National Museum, Washington, D. C...Charter
GILCHRIST, D. A., Box 765, Phoenix, Ariz.....Charter
GILMAN, M. FRENCH, Banning, Calif.....Charter
GILMORE, DR. MELVIN R., State Historical Society, Bismarck, N. D...Charter
GILPIN, F. ROBERT, 1212 S. 57th St., W. Philadelphia, Pa.....Charter
GLOYD, HOWARD KAY, Ottawa University, Ottawa, Kan.....1922
GOETHE, C. M., Capital National Bank Bldg., Sacramento, Calif.....Charter
GOLDMAN, MAJ. E. A., U. S. Biological Survey, Washington, D. C.....Charter
GOLDMAN, LUTHER J., State House, Boise, Idaho.....1922
GOLDSMITH, G. W., Alpine Laboratory, Carnegie Institution, 123 E. Washington St., Colorado Springs, Colo.....1922
GOODWIN, GEORGE G., American Museum of Natural History, New York City.....1921
GRAHAM, MAXWELL, Director of Park Animals, Canadian National Parks, Ottawa, Canada.....1922
GRANGER, WALTER, American Museum of Natural History, New York City.....Charter
GRANT, MADISON, 111 Broadway, New York City.....Charter
GRAVES, DR. WILLIAM W., Metropolitan Bldg., St. Louis, Mo.....1921
GREGORY, DR. WILLIAM K., American Museum of Natural History, New York City.....Charter

GRINNELL, DR. GEORGE BIRD, 238 E. 15th St., New York City.....Charter
GRINNELL, DR. JOSEPH, Museum of Vertebrate Zoology, Berkeley, Calif., Charter
GROSVENOR, GILBERT, Hubbard Memorial Hall, 16th & M Sts., N. W., Washington, D. C.....1921
GUTSELL, JAMES S., Bureau of Fisheries, Washington, D. C.....Charter
GYLDENSTOLPE, COUNT NILS, Naturhistoriska Riksmuseum, Stockholm, 50, Sweden.....Charter
HAAGNER, ALWIN KARL, National Zoological Gardens of South Africa, Box 754, Pretoria, Union of South Africa.....Charter
HAGERUP, H., Gothersgade 30, Copenhagen, Denmark.....Charter
HAIGHT, SHERMAN P., 61-63 Worth St., New York City.....Charter
HALL, F. GREGORY, Biology Bldg., University of Wisconsin, Madison, Wis.....Charter
HALL, FRANK S., State Museum, University of Washington, Seattle, Wash., Charter
HANKINSON, PROF. T. Leroy, Natural Science Hall, State Normal College, Ypsilanti, Mich.....Charter
HANNA, MARCUS A., c/o G. Dallas Hanna, California Academy of Sciences, San Francisco, Calif.....Charter
HANSON, DR. KARL B., Keeseville, N. Y.....1921
HARDISTY, ARTHUR H., 1426 Irving St., N. E., Washington, D. C.....Charter
HARKIN, J. B., Commissioner of Dominion Parks, Dept. of Interior, Ottawa, Canada.....Charter
HARPER, FRANCIS, Zoological Laboratory, Cornell University, Ithaca, N. Y.....Charter
HARRIS, HARRY, 18 W. 52nd St., Kansas City, Mo.....Charter
HARRISON, GEORGE L., 400 Chestnut St., Philadelphia, Pa.....Charter
HARTMAN, PROF. CARL, 511 W. 33rd St., Austin, Texas.....1921
HATT, ROBERT T., Museum of Zoology, University of Michigan, Ann Arbor, Mich.....1921
HAVEN, HERBERT M. W., 500 Forest Ave., Portland, Me.....Charter
HAY, DR. OLIVER P., U. S. National Museum, Washington, D. C.....1921
HAYNES, ALTA HALVERSON, 1734 University Ave., St. Paul, Minn.....1922
HEDGES, CHARLES FOOTE, Box 24, Miles City, Mont.....Charter
HELLER, EDMUND, Field Museum Natural History, Chicago, Ill.....Charter
HELLMAN, DR. MILO, 40 E. 41st St., New York City.....1921
HELME, ARTHUR H., Miller Place, Suffolk Co., N. Y.....Charter
HENDERSON, ARCHIBALD DOUGLAS, Belvedere, Alta.....Charter
HENDERSON, JOHN B., National Museum, Washington, D. C.....1922
HENDERSON, JUNIUS, 627 Pine St., Boulder, Colo.....Charter
HENDERSON, WALTER C., 4727 13th St., N. W., Washington, D. C.....Charter
HENNINGER, W. F., Cachoeira, Rio Grande do Sul, Brazil.....1921
HENSHAW, HENRY W., The Ontario Apartments, Washington, D. C....Charter
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